Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLII. NEW YORK, SATURDAY, NOVEMBER 14, 1903. No. 20.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, England.

NOTICE TO READERS WHO ARE NOT SUBSCRIBERS.

ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico - - - - - -	per year, $3.00
Foreign Countries, within the Postal Union - - - - -	6.00
Great Britain and Ireland - - - - - - - - - -	25 shillings
Germany - - - - - - - - - - - - - -	25 marks
France - - - - - - - - - - - - - -	31 francs
Single copies - - - - - - - - - - - - -	.10

Remittances for foreign subscriptions may be made through our European office.
In requesting your address changed give OLD as well as new address.

Copyright, 1903, by McGRAW PUBLISHING CO.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, NOVEMBER 14, 1903.

CONTENTS.

Editorial 791
The St. Louis International Electrical Congress 794
Failure of Municipal Ownership at Ashtabula, Ohio 794
Self-Starting, Single-Phase Motor Patent Decision 794
Doctors on Roentgen Ray Effects 794
Electric Towing on the Erie Canal 795
Distribution of Current in Three-Phase Systems. By F. Hardie Jeannin 797
Calculation of the Apparent Inductance of Armature Coils—I. By C. C. Hawkins 798
The Relative Reliability of Wireless and Wire Telegraph Systems. By Reginald A. Fessenden 801
An Improved Method of Testing Large Alternators Under Full Load Conditions—II. (Concluded.) By B. A. Behrend 802
New Generating Station of the Rochester Gas and Electric Company.... 803
Trolley Traction on the Miami Canal 804
Recent Electrochemical Developments 805
New Telephone Patents 806
The Telephone Crisis in Paris 807
Electricity for Swiss Railways 808
Kentucky Independent Telephone Association 808
Current News and Notes 808
LETTER TO THE EDITORS:
Impulse vs. Impact in Steam Turbines. By B. A. Behrend 810
Digest of Current Electrical Literature 811
New Books 815
A New Apparatus for Making Direct-Reading Measurements of Electrical Conductivity. By Wm. Hoopes 815
Induction Motors 817
Christmas Tree Lighting 818
DEPARTMENTS:
Financial Intelligence 819
Commercial Intelligence 819
General News 821
Trade Notes 825
Record of Electrical Patents 825

MUNICIPAL OWNERSHIP AT ASHTABULA.

It is fairly safe to assume that the State authorities of Ohio in investigating the accounts of the municipal lighting plant at Ashtabula, have done so without "prejudice." The State Auditor and his expert accountants ought to know what they are about, and hence we are inclined to accept without reserve the statement which we quote on another page as to the results obtained from their inquiry. It appears that the yearly cost to the taxpayers for ten years past has averaged $98.24 per arc light, and that not on an "all-night contract," but a moonlight schedule, subject without fines and rebates to the city's own construction of what moonlight may mean. There is not a central station company in the country in a city the size of Ashtabula that would not thank its stars for such a "cinch."

ELECTRICAL CONQUEST OF THE CANALS.

It seems to us more than an ordinary coincidence that we are able this week to publish accounts of two separate and distinct efforts to apply electricity to canal traction in this country. One equipment is on the famous old and fairly dilapidated Erie Canal; the other is on the Miami Canal in Ohio. The former is a direct-current aerial monorail system; the latter is a polyphase locomotive and track system. Both seem quite independent of the type of current used, for it is easy to imagine a change about to alternating current on the telpher line and direct current on the regular trolley track. But aside from that, there is an essential and radical difference in the method. The aerial line, as we can testify from actual observation, imposes no additional "servitude" on the towpath in the sense of obstruction. Anything or anybody can pass easily in either direction along the bank. With the trolley system, however, the whole bank is virtually occupied by the trackage, and it is easy to imagine serious objections to that plan. On the other hand, the "monorail" system looks so heavy it would appear easier and cheaper to lay the track right on the ground instead, and probably save money. In doing so, of course, one would give up the advantage of a clear bank for mule tows, etc.

These two are not the only methods, and we are glad to know, as recorded in these pages, that other systems are in vogue or under trial in Europe. The main point for which we contend, if, indeed, argument is necessary, is that electricity is wholly adequate to replacing the mule or the steam propeller on canals. Any one of these systems is feasible and a little time will soon develop the relative economies and efficiencies. And this statement is true, so far as the Erie Canal is concerned, whether the present small barges or the proposed new 1,000-ton barges are hitched to an electric motor. The bigger barges avoid breaking bulk, and we have ourselves seen over 1,000 tons in one tow manipulated with the greatest smoothness and quietude at fully 4 miles an hour. It is high time the decadent canals were rescued and put on the profitable level of modern trolley roads once operated by animal power.

THE WIRELESS TELEGRAPH CONFERENCE.

We note in the November *North American Review* a statement from Mr. John L. Waterbury, United States delegate to the recent wireless telegraph conference in Berlin, as to what was discussed at that important gathering. It would seem inevitable from his statement that another conference must soon follow if any practical results

are to be reached; and without general agreement it would seem that there must be trouble. When it is held, it is to be hoped that some respect will be shown for the rights of inventors and pioneers. Anybody who reads Mr. Waterbury's report can detect the tendency of the various governments to dispose of the whole subject as seemeth best to them, because of their alleged rights of eminent control over the telegraphs. It should surely be easy to put some restraint on rival systems without going to the other extreme and leaving them virtually stripped of reward or protection. All the great pioneer work of Marconi, for example, in oceanic wireless, is to go for nothing; and, unfortunately, according to, and possibly with the aid of, Mr. Waterbury, such a piece of high-sea robbery is to have the United States as a party to it. The Marconi Company is nothing to us, and we consider that Mr. Marconi still has to make good some of his most vital claims; but to brush their work aside or insist that *nolens volens* they or others shall be made to turn their land plant over to universal use by Tom, Dick and Harry, without due compensation, strikes us very much like high-handed confiscation. There is surely a more equitable way out of the difficulty than that.

For example, Mr. Fessenden might have a most expensive and elaborate tower system, while Dr. De Forest, without towers, might have signaling apparatus that everybody gave preference. If the Fessenden people, selling or leasing no apparatus, were compelled to receive all De Forest messages, as the present international scheme proposes, without right to secure some proper compensation, they might easily be bankrupted in six months, although on the use of their property the transmission depended. Other equally unfair combination of conditions under this ruling reported by Mr. Waterbury can readily be imagined. Even if a man is a common carrier, he has some common rights left.

GRAPHIC RECORDING AMMETERS.

At the last meeting of the American Institute of Electrical Engineers a paper was read by Mr. A. H. Armstrong upon a new form of recording ammeter, suitable for use on an electric car. Recording ammeters have been in use for some time in central station work; but such instruments are stationary. Moreover, the fluctuations of the current passing through such an instrument are rarely very rapid or very intense. The problem becomes distinctly modified and complicated when the apparatus has to be placed on a rapidly moving car, subject to jars and vibrations, and where the fluctuations of the current may be both very sudden and very intense. The instrument described is an ink recorder, and the pen is attached to the movable coil of an electro-dynamometer. This dynamometer differs from the ordinary form in having an iron core, and also in having a steady current supplied to the movable inner coil from a local source, such as a small storage battery. By this local supply of magnetization to the movable coil, intensified by the stationary central iron core, the torque tends to vary as the current strength in the fixed outer coil, rather than as the square of that current. This not only provides for a nearly uniform scale, but also ensures a much more powerful torque for weak currents, than could otherwise be obtained with a given full load torque.

The use of an instrument of this character is rendered necessary for the study of the starting behavior of traction motors under the conditions of practice. The curves of current and pressure at starting appeal as strongly to the trained eye of the traction engineer as the indicator diagram of an engine to the observation of the steam engineer. Another great advantage which this type of instrument possesses is its maintaining an accurate record of the pressure and current on a car over a given schedule, without having to detail an observer or observers for the purpose. There are few duties more fatiguing than that of recording a long series of voltmeter observations on a car at, say, ten-second intervals. The recording instrument, however, can register many changes within ten seconds should rapid fluctuations occur, and plot all the observations automatically.

An ideal car recording instrument would be capable of marking on one and the same moving paper ribbon the time, the speed, the distance, the grade, the volts, the amperes, and the kilowatt-hours. The mechanism for the synchronous recording of all these seven quantities would not be as very complicated. Four of the quantities may be derived from non-electrical mechanism, such as clocks and shaft-gearing. The remaining three electrical quantities should be more readily recorded on one and the same moving tape, than on three separate tapes. Such a mechanism might readily be transferred from one car to another, and would not require much time to connect on any car. Its record would give a complete history of a run over a road, and many practical problems might be satisfactorily solved by its use. Already recording machines are in use which combine several of these items. Machines of much greater complexity are already in use on steam railroads for recording the conditions of the track.

DISTRIBUTION OF CURRENT IN THREE-PHASE SYSTEMS.

We print on page 797 of this issue a very practical article, by Mr. F. H. Jeannin, on the distribution of current in three-phase systems. The three-phase system of mixed delta and star connections is relatively a complex distributing system. For example, it is a much more complex system to follow quantitatively than the four-wire two-phase system. Nevertheless, the three-phase system possesses the inherent advantage of a saving in copper of twenty-five per cent by comparison with any direct current system, single-phase system, or association of single-phase systems, of the same effective voltage. For this reason the three-phase system has come into practically universal use for the long-distance transmission of power. Consequently all propositions concerning the important quantities in the three-phase system, such as questions connecting voltages, currents and powers are likely to become of practical value.

The article points out that a pair of current transformers for operating line ammeters in a switchboard, are sufficient for the operation of all three line ammeters in a three-phase system. This is a consequence of the well-known laws of a three-phase system that at any instant the vector sum of the three-line currents is zero, and that the vector sum of the steady effective line currents is steadily zero—the effective current being the square root of the mean square, or the average heating effect, or the current as indicated by a properly calibrated alternating-current ammeter. This proposition is correlated with the well-known law of a three-phase system, that two wattmeters can be connected to indicate jointly the total power on the three lines.

Attention is very properly called to the fact that if the connections between the two current-transformers and the three ammeters are improperly made, the third ammeter will give misleading and erroneous indications. Another interesting proposition set forth in the article is that if, in a three-phase system, the three voltages of the generator delta, assumed equal and equally dephased, be drawn, like isometric coordinates, passing through a common point and spaced sixty degrees apart, then the algebraic sums of the com-

ponents of line currents resolved parallel to any three such adjacent lines will always be equal for equal generator output, no matter how much the apparent power, or volt-amperes may vary. The arithmetical sum of the three currents will, of course, tend to increase as the power factor diminishes, and as the volt-amperes increase, keeping the real power constant, but the resolved components of these currents on the coordinate axes will always maintain the same sum-total, when the sign of the components is taken into consideration. This proposition follows from the fact that the total power in the system is equal to the sum of the three voltages into the respective projections of the line currents upon them, and if this power is to remain constant, and the voltages are also constant, the sum of the three projections, or components, must also be constant.

From an observation of the line currents, and of the wattmeter readings, it becomes possible to determine the phase relations of the currents with the line voltages, and in this way to analyze the currents into working components on each line. This is on the assumption that the delta voltages are equal, but a slight modification of the proposition can be made to meet the case in which the delta voltages are unequal, corresponding to dissymmetrical terminal voltages.

ENGINEERING EDUCATION.

The recent visit of the British Commission investigating American methods of technical education brings to the front a very serious question as to the value of that which they have found. That technical instruction in England is in a highly unsatisfactory state admits of little doubt; it is quite certain also that the Commission discovered here some admirable institutions, but did they find a well-defined method of education which might fairly be said to be common to American technical schools? We think not, and on the contrary, if their investigations were at all as thorough as they were intended to be, they assuredly found that American institutions were on all sorts of planes of usefulness and representing all sorts of educational ideals. English technical instruction is essentially a development of the trade school idea, very useful in itself, but far from being all-inclusive in its functions. Here the trade school as such is almost an unknown quantity, and so far as it here exists is of comparatively recent growth. That it may be useful when intelligently managed the correspondence schools which have assumed some of its functions bear witness; but they cannot be regarded as a sequent part of our general educational system, which is based as regards technical instruction, on the small university using that term in its American signification of an institution in which all sorts of things are taught. The main work of technical instruction in this country is done by the "land-grant" colleges under State supervision and founded originally to provide instruction in "agriculture and the mechanic arts." In many instances the instruction in agriculture has been separated from that in the mechanic arts and the latter has been merged in the general work of a State University; but it is an impressive fact that technical study has been in every State of the Union backed up by a strong local appreciation of its necessity. It is in response to this sentiment that courses in engineering have been developed, and because of its representation of local necessities that they have taken the various forms in which they now appear.

In State institutions there is a direct pressure of popular feeling to which deference has to be paid, and that feeling to a considerable extent is governed by the nature and efficiency of the public schools. A group of endowed independent colleges and universities can and do exercise a very powerful influence on the public schools; but the State Universities must act by moral suasion, as they sometimes do with considerable effect. From such causes spring the curious anomalies which our British friends have certainly found. In electrical education the results are sometimes very singular, indeed. One finds, for example, two institutions in neighboring States, both with popular courses in electrical engineering, one of which contains perhaps as much as ten times more shopwork than the other. Now, evidently a student gets too much shopwork in one place or not enough in the other. Similarly one can find courses in which the students graduated in electrical engineering are merely mechanical engineers who have dabbled a few hours a week for a couple of years in an electrical laboratory without grasping fully a single fundamental electrical principle. Most courses in electrical engineering have been offshoots of a dominant mechanical engineering course, and these variations merely indicate the completeness or incompleteness of the gradual segregation which has been taking place. In fact, American electrical engineering reflects this origin. It has been mechanically clever, replete with the skill of the shrewd adapter and the tactful draughtsman. It has, too, been wonderfully successful up to a certain point along just these lines. The training has been vastly superior to that obtained in trade schools as such, but whether it is adequate for the future needs of the profession is a very different matter. A time has come in which the investigator must play in the principal rôle before the chorus of adapters appears upon the stage. And if one solemnly considers the really important electrical advances of the last quarter century or thereabouts it is somewhat startling to see how little of the great work has been done here or abroad by men whose training was wholly or chiefly in the direction of applied mechanics. The great work, both that which has been accomplished here and that which, arising abroad, has been subjected to benevolent assimilation, has, on the contrary, sprung from a very wide variety of sources. We hope, therefore, that our British friends will not go home bearing with them the idea that the American notion of electrical engineering is a concrete of machine design and strength of material with just enough dynamo testing to stick it together. We are very far from wishing to cast reflections on mechanical engineering, or in any wise to belittle its past and present usefulness to American industry, but in the present stage of electrical science it is far from being the whole thing. The electrical engineer of the twentieth century needs civil engineering, chemistry and general physics fully as much as he needs mechanical engineering, and more than any of these he needs some fundamental notions as to the methods and importance of research. The electrical industries are yearly getting more and more complex and making greater and greater demands upon general science; and engineering instruction must recognize this tendency and act upon it. In the past the main thing which confronted the student was the design, testing and operation of dynamos to which everything else in the ordinary electrical engineering course that smacked at all of electricity was subordinated. We are now in a different era. The problems which press for solution are of an entirely different order, and the men who are successfully to attack them must have a training wide and deep, as far from the old order of things as can well be. They have no time to waste on work that can be as effectively done in practice by a fifteen-dollar-a-week draughtsman, and no need for pottering over obsolescent fan motors. They have work to do for the progress of electrical science in the next generation, and what was useful or even essential twenty years ago may be a positive hindrance to-day. If American engineering is to take place as a world power in progress, it must originate instead of copy; and the power of origination, in whatever measure it may be influenced by training, needs a wider grasp upon fundamental principles than has ever before been required. Engineering education to be effective must be organized with almost prophetic instinct for the requirements of the years to come.

The St. Louis International Electrical Congress.

We are informed that the following appointments have been made by Prof. Elihu Thomson, president of the Committee of Organization of the congress for the officers of the various sections:

Section.		Subject.	Chairman.	Secretary.
A		General Theory Mathematical Experimental	Prof. E. L. Nichols, Cornell Univ.	Prof. H. T. Barnes, McGill Univ.
B	Applications.	General Applications	Dr. C. P. Steinmetz, Schenectady, N. Y.	Prof. Sam'l Sheldon, Poly. Inst., Brooklyn.
C		Electrochemistry	Prof. H. S. Carhart, Univ. of Mich.	Mr. Carl Hering, Philadelphia.
D		Electric Power Transmission	Mr. Chas. F. Scott, Pittsburg.	Dr. Louis Bell, Boston.
E		Electric Light and Distribution	Mr. J. W. Lieb, Jr., New York.	Mr. Gano S. Dunn, Ampere, N. J.
F		Electric Transportation	Dr. Louis Duncan, Mass. Inst. Tech.	Mr. A. H. Armstrong, Schenectady.
G		Electric Communication	Mr. F. W. Jones, New York.	Mr. B. Gherardi, Jr., New York.
H		Electrotherapeutics	Dr. W. J. Morton, New York.	Mr. W. J. Jenks, New York.

It is understood that all of these gentlemen, who are well-known specialists in the departments they represent, have already accepted these appointments, with the exception of one who has been unable to do so owing to absence in Europe, but who is now returning.

The section officers will have charge of the proceedings of the congress at St. Louis in their respective sections.

The papers that are to be read at the congress will be communicated by invitation from well-known authors in this country and abroad. They are to be read and discussed at St. Louis during the congress week 12-17th September, 1904. They are then to be printed and published in book form.

Invitations to join the congress are steadily being issued to persons and parties interested in electricity. Over 6,000 such circular letters of invitation will be sent out in the United States, and a similar number to foreign countries. Most of the circulars are being directed to members of electrical industries, societies and scientific institutions. Joining the congress entitles the member to attend the various functions at St. Louis and also to receive a copy of the subsequent transactions. It is expected that many will join the congress who cannot expect to attend the sessions in St. Louis, merely to receive the subsequently printed transactions. The transactions are expected to form a very valuable addition to electrical literature, both theoretical and practical. Already about 350 Americans have joined the congress in response to circulars, and only part of the circular catalogue has been covered. There is, consequently, every reason to expect a large and representative membership in the congress, both from this country and abroad.

Communications concerning the congress should be addressed to the general secretary, Dr. A. E. Kennelly, Cambridge, Mass.

Failure of Municipal Ownership at Ashtabula, O.

The examination of the accounts of the electric lighting plant owned by the city of Ashtabula by agents of the auditor of the State of Ohio has been finished. It shows that for the past ten years the city lights have cost, on the average, about $100 per year each, and this is for what is known as the moonlight, or short schedule, which gives at least 25 per cent. fewer hours' lighting than in Cleveland, where the contract price per light is $75 per year on an all-night, every-night schedule.

The original cost of the plant was $63,500.64 up to 1893 and from that year until August, 1898, $24,751.15 additional was expended for extensions and betterments. This brought the total construction cost up to $88,251.79. In 1898 a committee was appointed to fix the actual value of the plant, which was placed at $55,666.12, showing a depreciation below actual cost of $32,586.67, or over 7 per cent. per year.

The annual operating expense is $60 per light per year, which sum is paid by general taxation upon the taxable property of the city. No allowance is made for depreciation in this connection because the extensions and betterments made to the plant out of the revenues, without direct taxation on city property, approximate 7 per cent. per annum and practically provide for the depreciation as shown by the appraisement.

The sum of $19,525.36 has already been paid for interest charges on the bonded indebtedness and only $2,500 of this was derived from the revenues of the plant. This leaves $17,025.36 from the general taxation fund, or an annual cost of $40.54 per arc light. The cost of the plant to the city of Ashtabula for the years 1892 to 1898 is made up as follows: For operation, $60 per lamp; for interest on bonds, $40.54; for lost taxes, $9; total, $109.54 per lamp per year. This does not include the loss in county and State taxes, approximating $4.65 per annum.

From 1898 to December 31, 1902, the cost was somewhat reduced. The operating expenses were $60 per annum, while interest charges were reduced to $31.45. The charge for lost taxes was $9.10 and, with loss in State and county taxes, $13.75, a total of $105.20.

The cost to the taxpayers for the six years ending 1898 is given as $685.14 per lamp; for the four years ending 1902, $292.28, a total for ten years of $982.42, or an average cost per annum of $98.24 per light, and that on the moonlight schedule.

Self-Starting Single-Phase Motor Patent Decision.

The United States Circuit Court of Appeals, sitting in New York City, has handed down an opinion sustaining a decision rendered by the Circuit Court of the same district, declaring that the Wagner single-phase motor does not infringe, as alleged, a patent granted June 17, 1890, to Elihu Thomson. The lower court held that the Thomson patent, which was claimed to cover broadly the use of "locally closed circuits" in the starting of motors, was a mere paper patent; that it does not appear that any motor had ever been made under the patent, while on the other hand, the defendants have developed the class of motors claimed to infringe the Thomson patent.

In its opinion the Court of Appeals states that it is entirely satisfied that the term "locally closed circuit" as used in the claim of the Thomson patent, means, as one of the experts has expressed it, that all the coils of the armature are closed upon a circuit which is local in that it is independent or disconnected from every other circuit but that established through the armature coil. The Thomson claims emphatically state that in the motor of the patent this condition of a locally-closed circuit in the armature-coils must be found when the motor is running at the predetermined speed. With equal emphasis they state that this "locally-closed circuit" is a *change* from the condition existing while the motor is being started; that is to say, the locally-closed circuit of the running motor is not to be found in the starting motor. In the starting condition and in the running condition alike the armature coils of the Wagner patent are on locally closed circuit, and however slight may be the difference between this motor and the motor of the patent, infringement cannot be predicated of claims phrased as are those in the Thomson patent.

Doctors on Roentgen Ray Effects.

The Society of Medical Jurisprudence, at a meeting held in the Academy of Medicine, New York City, this week, discussed the subject of the application and effect of the X-ray. Dr. Carl Beck read a paper on "The Medico-Legal Aspect of Accidents Caused by the X-Rays." "Undesirable results," he said, "frequently attended the use of the X-ray, even when it was applied by the most careful and expert operators. There was no person who would not be burned by the ray if he were exposed to it long enough. One way to avoid these distressing consequences was to study carefully the condition of the patient, and in this way determine, as nearly as possible, the proper duration of an exposure. Whereas some persons may be subjected without harm to long exposures at frequent intervals, in other cases it is imperative that the exposures should be short and given at long intervals."

Dr. Samuel Lloyd attacked the members of the legal fraternity for their ignorance of things medical. "The questions which are put to us in trials for damages resulting from the use of the X-ray," said he, "it is utterly impossible to answer, for the simple reason that the lawyers are unable themselves to understand the subject under discussion."

Dr. William J. Morton dwelt on the use of the ray in the treatment of cancer. "While it will cure cancers which are not deep set," said he, "as for example, those of the face, it cannot be relied on as of much real value in curing those which are located in less accessible parts of the body, as in the chest or the abdomen." He did not agree with Dr. Beck that everybody is liable to be burned by the treatment. "Why," said he, "I have a patient whom I've been trying to burn for a year, and he simply won't burn."

Electric Towing on the Erie Canal.

THE Erie Canal has been the scene of various attempts to haul barges by electricity, but although other canals in Europe and America have now been equipped with electric tractors of one kind or another, the famous old artificial waterway between Albany and Buffalo is still dependent upon mules and a few steam propellers for its motive power. It has thus been left in such hopeless competition with the railroads that the people of New York State have just voted to spend a sum of over $100,000,000 upon the Erie, Oswego and Champlain Canals in order to render them capable of floating 1,000-ton barges instead of those now employed with a capacity not exceeding 250 tons. The fact that electricity is not less applicable to the larger barges than the small ones gives special interest to the renewed demonstrations during the past fortnight upon the Erie of electrical methods differing in many respects from those already tried there.

The first electrical tests on the Erie Canal date back to 1893, when Mr. F. W. Hawley equipped with two Westinghouse electric motors an old steam propeller so as to drive the screw and took current by trolley from cross span wires on a pole line running along the bank, near Rochester. The test was at once successful, but the plan was open to the objection which applies to the propeller at any decent rate of speed, namely, the undue suction and wash caused, detrimental to the bank. Moreover, the lateral motion created various difficulties with the trolleys, two of which were employed. The next plan tried was that of Mr. Richard Lamb, C.E., who introduced an ingenious cableway supported along the towpath on short, substantial columns, with a telpher motor traveling along two cables, placed one above the other, the upper for bearing and the lower for traction. With this motor went a man to handle the mechanism and controller. This system was shown in operation at Tonawanda, N. Y., as well as on the Raritan Canal; but for various reasons was not developed further. Meantime on the Miami Canal a polyphase system has been introduced with a hauling trolley locomotive on a regular track; while in Europe practical systems are in use, as described already in these pages, employing automobile electric tractors running along the bank without tracks, but taking current from overhead trolley circuits.

The newest system is that of Mr. Stephen W. Wood, shown in operation on the Erie Canal opposite the General Electric factories at Schenectady, by the International Towing and Power Company, of New York. It is a monorail system resembling methods already advocated by Messrs. Sachs in America and Thwaite in England; but having been worked out with considerable novelty, care and attention to engineering details. The experimental track is about 2,700 ft. in length, with a sharp curve, and furnishing a good average section of the 7-ft. prism. Along the bank are erected every 25 ft. short posts set in concrete and supporting, on each side of the post, about 3 ft. apart, continuous plate 18-in. girder, the girder farthest away from the canal being raised above the inner one, as in a tier of seats. The girders are cross braced so as to stiffen the structure; and, indeed, the whole work is of a most substantial character—too heavy, it would even seem, for the work in hand. The edges of each girder are faced with light 3-in. rail for track. Over the two girder tracks extend a series of ordinary trolley brackets carried on poles set at the outer edge of the canal bank and carrying a trolley wire so placed as to be readily accessible to a trolley reaching up from either track. The construction of the track and the pole line, with relation to the canal, can be seen already from Figs. 1 and 2.

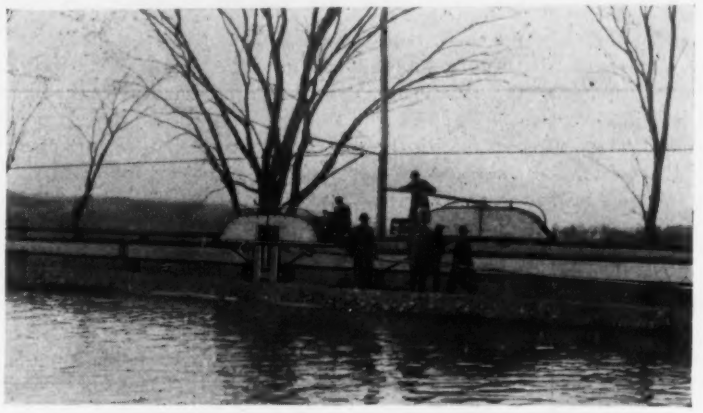


FIG. 2.—TOWING MOTORS PASSING EACH OTHER.

The "electric mule" is very clearly illustrated, complete and in detail, in Figs. 3 and 4, and will be easily understood, although we are not at liberty to reproduce structural drawings. The mule is a vehicle closely resembling a "hog-back" mine locomotive, and is 10 ft. long by 2 ft. wide, and 3 ft. high from the rail. It is ironclad for better protection from the weather, but, as the photographs indicate, all the mail is quickly removable and all the parts are accessible. At each end is a 40-hp motor of street car, narrow-gauge type; but, owing to the low speed required, geared down by double reduction in the ratio of about 40 to 1. Both sets of gear are shown in one of the views, on the exposed side, the first reduction from the motor armature axle to the first gear being seen in front, while the second reduction set of the rear motor are seen at the rear. Each motor thus drives a grooved wheel about 22 in. diameter, which travels upon the upper rail; and, by reversing, the motor runs promptly backward and forward. At the rear end is a mining locomotive or rheostatic controller, and a resistance box serving as a seat for the driver, who would doubtless appreciate its warmth in such weather as accompanied some of the recent tests. The "mule" has two large hooks for the towropes and has also a running board

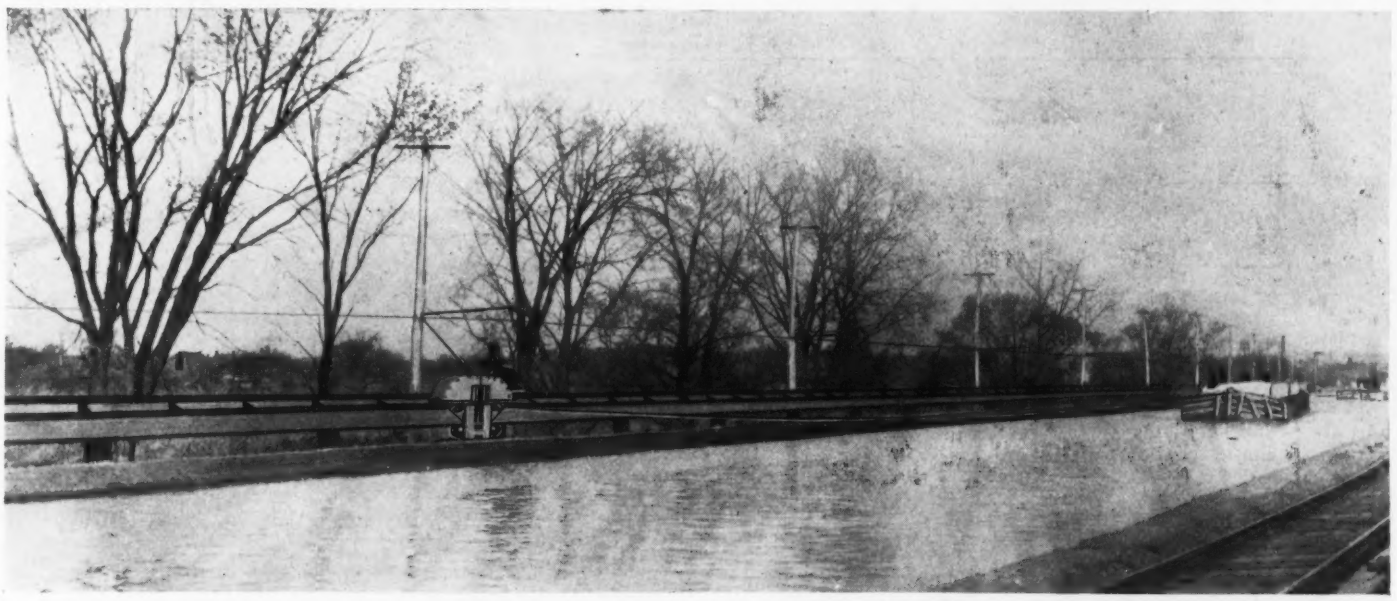


FIG. 1.—MONORAIL ELECTRIC TOWING ON THE ERIE CANAL. A TOW OF FOUR LOADED BARGES.

and guard hand rail, seen in Fig. 2, so that the driver can go around the machine without dismounting. Reaching upward from the center of the top shell of the motor is a stout, short mine trolley, which can be pulled down so as to let another "mule" go by on the upper or lower track. The method of doing this simple operation is shown in Fig. 2. Obviously, two wires, one for each track, could be strung if desired.

From the body of the motor mule extends downward a heavy arm, which carries springs pulling upwards two grooved wheels so as to exert a gripping effect on the under rail. This tension spring can be loosened or tightened at will, and the arrangement serves to keep the tractor steady, besides affording additional adhesion, to such an extent that the traction effect due to the weight of the motor —over five tons—is virtually doubled, the "draw-bar pull" reaching, it is said, over 30,000 pounds. The amount of power or current consumed varies, of course, with the speed, the weight hauled, the depth of the prism, the condition of the track and other factors. In this connection it may be stated that a number of readings have been taken under all conditions, from which, later, a variety of interesting conclusions may be deduced. The current is direct, furnished from the General Electric plant to the motors at 475-500 volts. It would be fair to assume that in practice, if necessary, instead of rectifying the current, single-phase or polyphase motors could be used, after stepping down the supply from such points as Niagara, Spier Falls, Mechanicville, etc.

As to the tests themselves, they have been made in the presence of Governor Odell, State Engineer Bond, the Canal Commissioners, the Superintendent of Public Works, and others, and have naturally attracted public attention. As seen by one of the editors of ELECTRICAL WORLD AND ENGINEER, they included the hauling of two boats each loaded with over 200 tons, at a speed up to 4¼ miles an hour, as recorded by tachometer in the observation car keeping

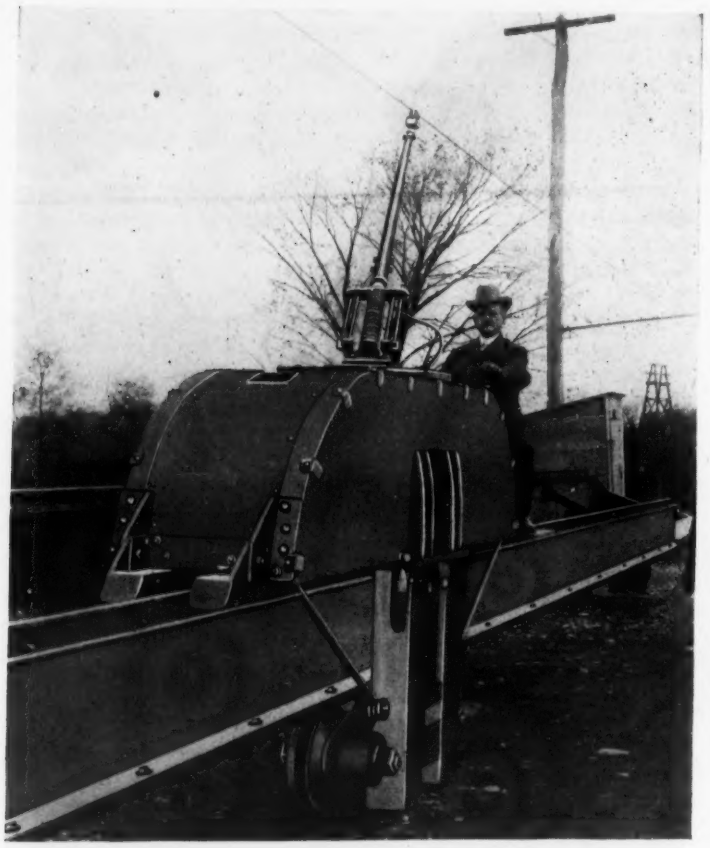


FIG. 3.—TOWING MOTOR SEEN END ON.

abreast over the run. These two boats would represent a total weight of probably 600 tons. Other tests included the haulage of four loaded barges at various speeds up to the same figure. In every instance the slight wave motion in the canal, or absence of wash, was most noticeable, the disturbance dying out in a mere ripple as it reached either bank. This would appear due to the steadiness of the breast pull and the abolition of the churning action consequent upon the use of a screw propeller. Some of the tests seen by the writer were conducted in a heavy snowstorm, but little, if any, difference was observed in the results; while part of the monorail track was at times sanded by the driver to improve the tractive effect after some of the squalls. During the tests one or two mule tows passed in the opposite direction, making barely a mile an hour on the wet towpath. The contrast between the two systems was most striking, while it was not to be forgotten that both the old and the new methods were operating at the same time without interference.

Aside from the engineering superiority of an electric motor on a track over a mule on a yielding towpath, the main question is that of economic efficiency. It would be a fair inference that, as on the trolley roads, mechanical power applied electrically has all the ad-

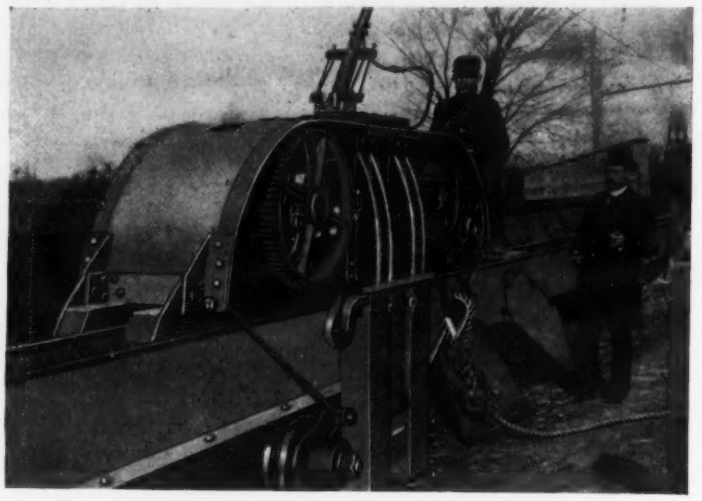


FIG. 4.—TOWING MOTOR WITH PART OF CASING REMOVED.

vantages. Awaiting further data, it may be well to cite, without approving, the claims of the company undertaking these tests. The cost of equipping the Erie Canal, 352 miles, with the Wood system, is estimated to be:

Structure electrically equipped for 80-hp	$6,290,000
300 motors, 80-hp	750,000
Total	$7,040,000

The gross earnings from the operation of the system, estimated at 50 cents a ton for 10,800,000 tons, would be $5,400,000. The operating expenses would be: Four per cent. on equipment, $281,600; cost of 24,000 hp,seven months' use at $35 per hp per annum, $490,000; wages, motormen for 300 motors (three men each) 8-hour shifts, $378,000; trackmen, $11,340; repairs, salaries, etc., $150,000; total, $1,310,940, making the net earnings $4,089,060.

The General Electric Company is in nowise associated with the enterprise, but has built the motors and furnished current, in the belief that it is proper to encourage such efforts. Mr. Carl W. Larsen, of its mining department, has put a good deal of time on the work, while Messrs. W. B. Potter and A. P. Jenks, of the railway department, have accumulated a large amount of data. The structural steel work of the track was all furnished by the Jones & Laughlin Company, of Pittsburg.

Telegraph Wire Garments.

The native women in the East African Protectorate have conceived a remarkable longing for telegraph wire. They find that nothing so completely adorns their scantily-draped persons as a few yards of telegraph wire wound around their waists and serving as a girdle. The toilet of no fashionable belle is complete without it. They wind it around their bodies and permit it to remain, even during the hours of slumber. No telegraph wire as yet has been imported to meet this fashionable demand. The result is that the stocks of wire imported for the sole purpose of stringing on poles were depleted until the authorities became fully aware that telegraph wire was the rage of the hour. In the interests of telegraphy the white officials now keep their wire under lock and key and hold the tribal chiefs responsible for the integrity of the lines through their territories.

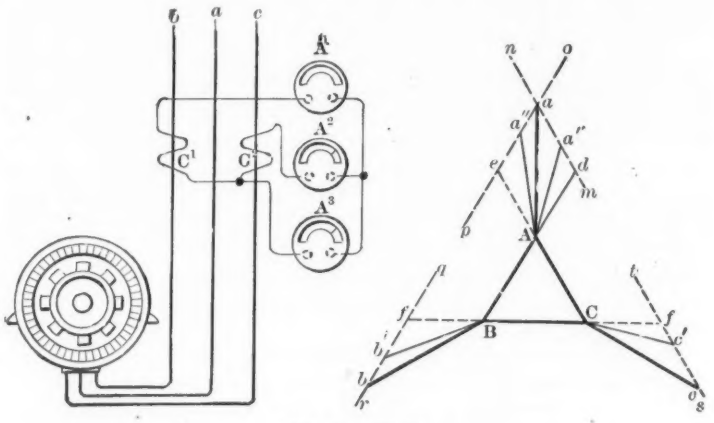
Distribution of Current in Three-Phase Systems.

BY F. HARDIE JEANNIN.

WHILE the following method of connecting up ammeters is not new, yet the analysis no doubt will prove new and interesting to practical electricians and station men in general. To those not acquainted with the theory of alternating current phenomena, it would appear at first sight that three ammeters connected to two current transformers as shown by the diagram of Fig. 1 would not give accurate results. That the ammeter connected in the common return of the transformers does give the current in the lead in which there is no current transformer, is easily understood when we remember that at any instant the sum of the amperes in any two leads is equal to the amperes in the remaining one.

The diagram of Fig. 2 will help make clear the shifting or change of relation that goes on when the distribution of the system is in any way disturbed. *ABC* is the delta of potentials for the three phases, and *Aa*, *Bb* and *Cc* are the currents in the leads at *A*, *B* and *C*, respectively, for balanced conditions. The point *a* can move along *mn* or *op*, in which case a corresponding change will occur in the location of point *c* or *b*, respectively. For the sake of simplicity, in the first case, *a* moving along *mn*, *Ad* is supposed to remain constant; and in the second case, *a* moving along *op*, *Ae* is supposed to remain constant. Suppose *a* is moved to *a'*. What is the result in regard to *b* and *c*? Since the current in phase with *AB* and *BC* is not altered by the terms of the supposition, it remains that the current in phase with *AC* only has varied. Therefore, the component *ad* of *Aa* is reduced from *ad* to *a'd*. And consequently *fc'* must be equal to *a'd*. Therefore, swinging *Aa* to *Aa'* causes *Cc* to swing to *Cc'*; no change occurring in the position of *Bb*, which means that the current in the lead at *B*, represented by *Bb*, has not undergone any change, either as to its phase relation with the potentials or its magnitude.

Again, suppose the point *a* moves along *op* to *a''*. Then *ae* becomes *a''e*, and consequently *bf* becomes *b'f*, *a''e* and *b'f* are, of course, equal. Also the point *c* remains unaltered. The lines *mn*, *op*, etc., are drawn here for balanced conditions merely as a nice starting place for the discussion. Therefore, for either balanced or unbalanced conditions, when any one of the three points *a*, *b* or *c* is moved along one of the lines, as *a* along *mn*, a corresponding change will occur in one of the remaining points, and no change in the third point. That is to say, when the change in the current distribution of a system falls within the terms of the above supposition, only two ammeter readings will be affected. If, however, a change should occur that would cause any point, as *a*, to leave the lines, as



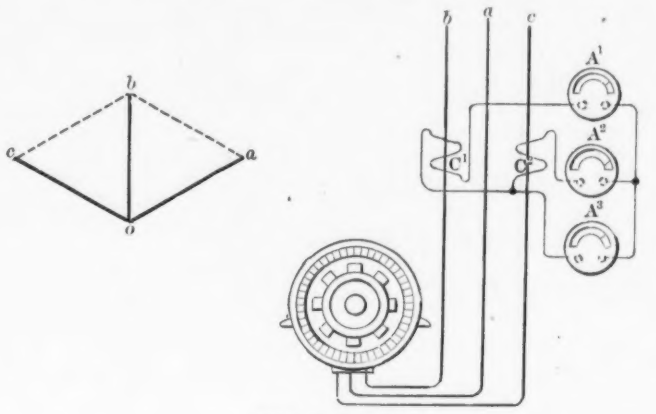
FIGS. 1 AND 2.

mn or *op*, a change will occur in all the points, which means that all the ammeter readings will vary, instead of only two.

That the amperes recorded by ammeter A^3 is the resultant of the current in transformers C^1 and C^2, is also shown by the diagram of Fig. 3, where *ob* is the resultant. The diagrams of Figs. 2 and 3 will always give the same results. The diagram of Fig. 3 is for balanced conditions, and shows that *Aa* of Fig. 2 is the resultant of *Bb* and *Cc*.

If the connections were made as shown by the diagram of Fig. 4, the reading of ammeter A^3 would be as shown by *ob* of Fig. 5 for balanced conditions, which is clearly wrong; the readings should all be equal as in Fig. 3.

By conceiving *ABC*, Fig. 2, to become infinitely small, the points *A*, *B* and *C* will come together and form a single point, as *o* in Fig. 6. This brings us to the diagram of Fig. 6, in connection with which some interesting things will be noticed. Draw *AA*, *BB* and *CC* parallel to the potential vectors, and draw *oa*, *ob* and *oc* to some convenient scale to represent the currents in the three leads as given by the ammeters, the load being balanced.



FIGS. 3 AND 4.

Now, it is easily proved that for any given output, the sum of the three different sides forming the parallelograms is constant; for instance, the sum of ad_1, d_1o and oe_1 is constant for any condition of current distribution so long as the output remains the same. This statement can be put in a condensed form as follows:

$$(a+b+c)=k. \qquad (1)$$

where *a*, *b* and *c* are the three different sides, and *k* is their sum, which is constant for any given output. Since two of these sides are the components of the current as obtained from one of the ammeter readings, it follows that with one ammeter reading and angle ϕ or ω the other two readings can be obtained, and also their phase relation.

The first thing to do is to find the value of *k* in formula (1). To do this, note the output in watts from the indicating wattmeters. Then, proceeding as if the load were balanced,

$$I=\frac{W}{\sqrt{3}\,E}. \qquad (2)$$

also,

$$ad_1=\frac{I}{\sqrt{3}}, \text{ and, } I=ad_1\times\sqrt{3}. \qquad (3)$$

then from (2) and (3),

$$ad_1\times\sqrt{3}=\frac{W}{\sqrt{3}\,E}, \text{ and, } ad_1=\frac{W}{3E} \qquad (4)$$

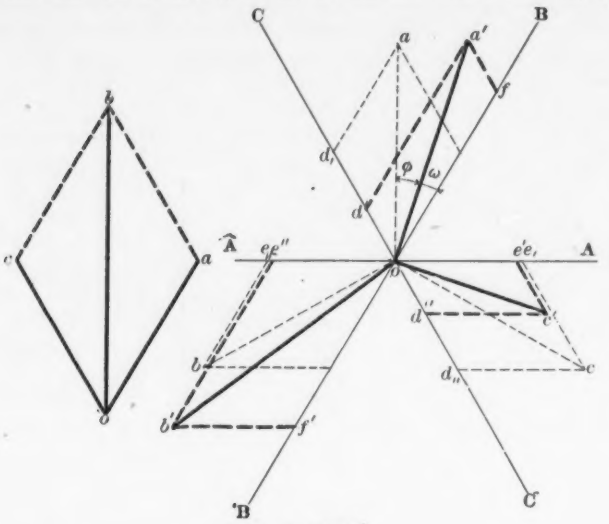
Since $ad_1=d_1o=oe_1$, $(ad_1+d_1o+oe_1)=3\times ad_1$, by multiplying (4) by 3 we get, $3\times ad_1=\frac{W}{E}$. Since ad_1, d_1o and oe_1 are the three sides, they can be represented by the letters *a*, *b* and *c* of formula (1); then $k=\frac{W}{E}$. Consequently,

$$(a+b+c)=\frac{W}{E}. \qquad (5)$$

Let *a* and *b* be the two components of one of the ammeter readings as before mentioned. Then from formula (5) the remaining side, or *c*, can be obtained; that is,

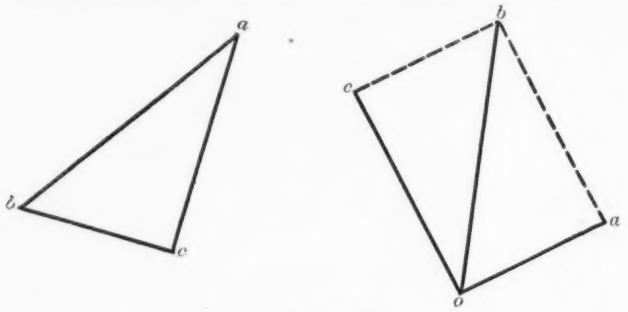
$$c = \frac{W}{E} - (a+b). \qquad (6)$$

We can now proceed with the diagram of Fig. 6. From formula (2) we obtain the value of *oa*, *ob* and *oc*; then with *oa'* as the known ammeter reading, at angle ϕ to *oa*, lay off *oa'*. Next draw *a'f* parallel to *CC*, and *a'd'* parallel to *BB*. Let $a'd' = a$, and $d'o = b$, then *oe'* will equal *c*; then from formula (6) find the value of *c*, and lay it off on *AA* both sides of *o*, that is, *oe'* and *oe''*. Also on *CC* lay off $od'' = od'$, and on *BB* lay off $of' = of$. Complete the parallelograms with these lines as sides, and draw *ob'* and *oc'*, which will be the current in the other two leads.



FIGS. 5 AND 6.

If the results of Fig. 6 are correct, the vectors *oa'*, *ob'* and *oc'* should form a closed triangle; which is done in Fig. 7, showing the method to be correct. Also in the diagram of Fig. 8 the current represented by vectors *ob'* is shown to be the resultant of the currents represented by vectors *oa'* and *oc'*. The angle ω can easily be obtained if the wattmeter is connected in the lead corresponding to *oa'*, its potential coil being connected to the phase whose e.m.f.



FIGS. 7 AND 8.

is parallel to *BB*. Let W^1 be the wattmeter reading, I^1 the current in that lead, and E^1 the potential.

Then $W^1 = I^1 \times \cos\omega \times E^1$, whence

$$\cos\omega = \frac{W^1}{I^1 E^1}. \qquad (7)$$

From a table of cosines the angle can be obtained. The ammeter whose reading is to be used must be in the same lead as the wattmeter from which the angle is determined. The two wattmeter readings are W^1 and W^2, and hence, W of formula (5) is equal to $W^1 + W^2$. Therefore, as far as the analysis is concerned, one ammeter is sufficient when there are two indicating wattmeters in circuit.

Reprieved by Telephone.

Governor Yates, of Illinois, recently granted long-distance clemency to a murderer, to avoid the possibility of a fatal delay in the mails. The sheriff was thus informed of a stay of execution over the telephone, but to make assurance doubly sure, a telegram was sent at the same time.

Calculation of the Apparent Inductance of Armature Coils.—I.

By C. C. Hawkins.

1. *The two inductance quantities involved in commutation.*

In order to forecast the behavior of a dynamo from the point of view of sparkless running under varying loads, it is imperative that the designer should, among other calculations, make an estimate of the value of two highly complex quantities,* and such estimates, even if only approximate at the best, must be made with all the accuracy that he can command. The first of these quantities is the apparent self and mutual inductance ($L + \Sigma M$) of a section of the armature winding, on the assumption that all sections which are simultaneously short-circuited at a pair of adjacent brushes of opposite sign assist one another in retarding commutation, and though not necessarily at the same stage of commutation yet have a rate of current change equal and of the same sign. For this to be the case, the short-circuit current when plotted in relation to the time of commutation, *T*, must evidently give an inclined straight line passing across the horizontal axis of time from the full normal value $+J$ on the one side to $-J$ on the other side of the diagram; the rate of change is then throughout constant and corresponds to a uniform current density over the contact surface of the brushes. The required inductance is an "apparent" one, since the flux which passes through the pole faces and thence onwards through the iron of the yoke has its variations damped out by the closed circuit of the exciting coils which surround the main magnetic circuit, so that its effect in the present connection is to all intents eliminated.† The second quantity is the apparent self-inductance of a section (L_s). due to the divergence of the actual short-circuit current from the inclined straight line, and on the assumption that the other sections which are simultaneously short-circuited but are not at the same stage of commutation are carrying the straight-line current, and thus so far as the excess or deficiency of current in the first section is concerned have only a damping action upon it; the second quantity has, therefore, especial reference to the last moment when the short-circuit is opened, and is "apparent" in a double sense, since it takes into account not only the damping action of the exciting coils, but also that of the other sections simultaneously short-circuited.

Both quantities in reality alter for different positions of the section under consideration within the slots of a toothed armature and for different positions within the interpolar gap; but in every case in order that any error may be on the safe side, the maximum value should, as far as possible, be taken, since upon this will depend in the main the tendency to sparking. During the process of design, the inductance can necessarily only be calculated, yet if the calculations are carried out by definite rules they yield comparative results of great value. A résumé of the general principles of the calculation may, therefore, be of service to the designer, and in the present paper will be supplemented by a consideration of the effect of different windings (especially in reference to the permeance of the surface of the armature core between the pole tips) in greater detail than the subject usually receives. Much might be done by experiment in the laboratory of the college or university to bring such results into closer relation to actual facts, yet in default of tests to check the somewhat arbitrary assumptions the designer must remain content with approximate *comparative* results, and must wait for future experiment to add the necessary qualifying or corroborative factors.

2. *The three components of armature inductance.*

The inductance of a section is divisible into the three parts corresponding respectively to the slot, to the surface of the core between the pole tips (all variations of the flux under the pole faces being *ex hypothesi* neutralized by the exciting coils), and to the end connections. The first item may be divided into the portion (*a*) due to the flux within the slot proper, and (*a'*) that due to the flux across the opening of the slot which may have overhanging edges; the former depends on the number of layers, etc., but for a given disposition of the winding is proportional to the ratio of the depth of the slot to its width, or to $\frac{l}{w_s}$; the latter is proportional to the ratio of the height of the opening to its mean width, or to $\frac{l_3}{w_3}$ (Fig. 1).

* See Arnold, Die Gleichstrommaschine, Vol. i, Chap. xvi.

† See H. N. Allen, "Sparkless Reversal in Dynamos," Journal Inst. Elect. Eng., Vol. xxvii, p. 209.

The second item is divisible into the portions corresponding to the joint flux linked with all the simultaneously short-circuited sections (b), and to the local fluxes immediately linked with the section under consideration (b') or with two or more ($b'' + b''' + \ldots$). All the foregoing are proportional to the length of the core (l), and may be expressed through a term giving the virtual permeance of the core per centimetre of its length. The third item, on the other hand, has to do with the end connections and their length (l'). The expression for the apparent self and mutual inductance of one section in a lap-wound armature will, therefore, take such a form as the following:

$$L + \Sigma . M = \left(\frac{\tau}{N_2}\right)^2 \left[l \left(a . \frac{t}{w_s} + a' . \frac{t_3}{w_3} + b + b' + b'' + b''' + \ldots . \right) + l'c \right] \times 10^{-9} \text{ henrys,}$$

where τ is the number of active inductors counted all round the armature, and N_2 is the number of commutator sectors.

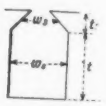


FIG. 1.

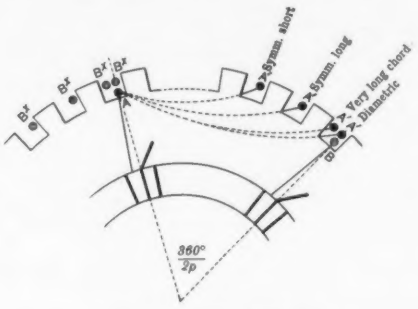


FIG. 2.—SUBDIVISION I. A.

Considering a lap-wound drum armature in which the number of wires in a spool side is $w = \frac{\tau}{2N_2}$, let it be assumed that the winding is disposed in two layers, and that no spool side is divided between two or more slots, any such division being an exception to the general rule of modern machines.

3. *Classification of windings and definition of terms.*

For the purpose of studying the effect of different arrangements of the winding, the cases which are of frequent occurrence in practice may be conveniently grouped into certain classes. The primary division must be into (I) those in which the number of commutator sectors per pole, or $\frac{N_2}{2p}$ is *whole,* and (II) those in which $\frac{N_2}{2p}$ is a *fractional* number. The difference between the two is that in the former class if the position of the short-circuited spool sides in a pair of consecutive interpolar zones has been set out, the remaining

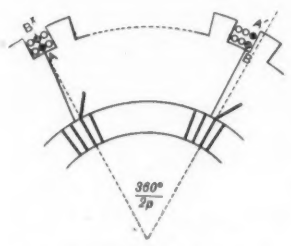


FIG. 3.—DIAMETRIC I. B.

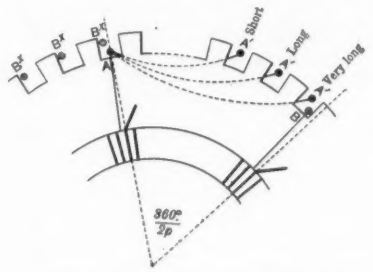


FIG. 4.—VERY LONG, SYMMETRICAL LONG AND SYMMETRICAL SHORT I. B.

interpolar zones in the multipolar machine are merely repetitions of the first pair. In the latter class each pair of interpolar zones is not necessarily similar to every other. With toothed armatures which are more especially to be considered, the former class must again be subdivided into (IA) those in which the *number of slots* is *divisible by the number of poles,* whence every interpolar zone is precisely similar to every other, and (IB) those in which consecutive zones are dissimilar, owing to the *number of slots not being divisible by the number of poles.* Lastly, account has to be taken of the span between the two sides of a spool relatively to the pole pitch. Thus for the purpose of defining the various principal cases, let a narrow width of brush be taken, only just exceeding the thickness of a mica insulating strip, and let spool $A\,A'$ be at the moment undergoing short-circuit at one brush, say of positive sign; then in class (I) a second spool, $B\,B'$ is also undergoing short-circuit at the neighboring negative brush, and in each pair of interpolar zones there are four spool sides short-circuited. In subdivision (IA) when the one side, A, of a spool short-circuited at the positive brush is on the interpolar line of symmetry, the corresponding side, B, of a spool short-circuited at a neighboring negative brush will also fall on an interpolar line of symmetry. If now the second side, A', of the first spool falls immediately above or below B, A will also be correspondingly situated below or above the second side B^x, of some spool which is also short-circuited, and the winding by analogy from the two-pole case may be termed *diametric.* In the absence of this condition the armature is more or less chord-wound, and by reference to the span in teeth of the rear end connection (not to the pitch in spool sides), the different degrees of chord winding in common use may be arbitrarily defined and named as follows:

Very long chord, when the degree is so small that spool side, A', falls within the same slot as B, although not immediately above or below it.

Long chord, when spool side A' falls within the slot adjacent to that of B, so that A' and B (or A and B^x) are separated by one tooth.

Short chord, when spool side A' falls within the slot next but one to that of B, so that A' and B (or A and B^x) are separated by two teeth and one slot. All these cases may be identified from Fig. 2.

With class (IB) if the two sides of a single element do not occupy similar positions within their respective slots, it is still possible for the winding to be *diametric,* so far that is to say that A' and B (or A and B^x) fall one above the other in the same slot (Fig. 3); yet if the number of sectors simultaneously short-circuited at each brush is increased beyond one with four spool sides per slot or beyond two with six spool sides per slot, a divergence arises from

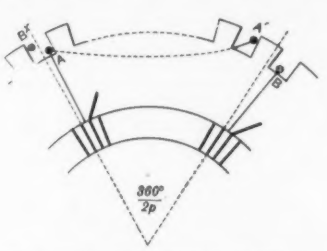


FIG. 5.—ASYMMETRICAL LONG I. B.

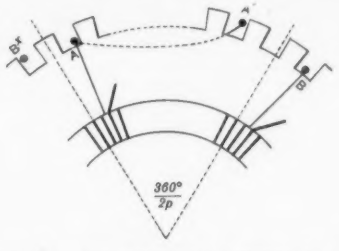


FIG. 6.—ASYMMETRICAL SHORT I. B.

the inductance of the true diametric winding of (IA). With completely interchangeable coils the following cases may be distinguished:

Very long chord, when it is still possible for the two spool sides short-circuited in each zone to fall within the same slot; thence if the span be shortened by one tooth there results *symmetrical long chord,* or if shortened by two teeth, *symmetrical short chord* under the present class (Fig. 4). Or the two consecutive zones may be entirely dissimilar, and we have *asymmetrical long chord* when in one zone A and B^x fall within the same slot, while in the other zone A' and B are separated by one tooth, and *asymmetrical short chord* when in one zone, A and B^x, are separated by one tooth, and in the other zone A' and B are separated by two teeth and one slot. Thus the asymmetrical cases fall respectively midway between the very long and symmetrical long chord of class IB, and between the symmetrical long and symmetrical short chord of the same class (Figs. 5 and 6).

In class II with $\frac{N_2}{2p}$ fractional, the pair of consecutive zones giving the maximum inductance must be chosen if the armature be multipolar, since the remaining zones or some of them are dissimilar. For the purpose of defining the various cases, if the same narrow width of brush, barely exceeding the thickness of a mica strip, be taken, let spool $A\,A'$ be short-circuited at one brush; let the other spool sides in the same interpolar gaps which are connected to the sectors on which the brushes rest be lettered B and X, the former being near to A' and the latter to A. The immediate difference from class IB is that with our narrow brushes, B and X

are now not short-circuited and are, therefore, shown by dots and crosses as carrying oppositely-directed currents (Figs. 7, 8 and 9). By the positions of B and X relatively to A' and A we have the analogous cases to those of class IB, viz.:

Very long chord, when A' and B can fall in the same slot, and also X and A;

Asymmetrical long chord, when the one pair falls within the same slot, but the other pair is separated by one tooth;

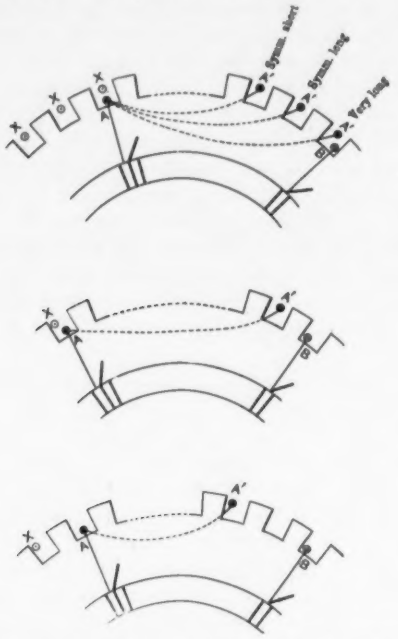


FIG. 7.—VERY LONG, SYMMETRICAL LONG AND SYMMETRICAL SHORT II.
FIG. 8.—ASYMMETRICAL LONG II.
FIG. 9.—ASYMMETRICAL SHORT II.

Symmetrical long chord, when in each case a tooth intervenes;

Asymmetrical short chord, when the one pair is separated by a tooth, and the other pair by two teeth and a slot;

Symmetrical short chord, when in each case a pair of teeth and a slot intervene.

As long as the spool sides are situated within the slots and in the sumption of a very narrow brush width, the practical cases of greater brush widths by which more than one section is short-circuited at a time must be plotted and the diagram of the short-circuited wires in a pair of interpolar zones be built up. A specimen of the process is given in Fig. 10, where the case of six spool sides per slot is worked out for brushes of such width as to short-circuit three, four or five sections at a time. In all cases the section chosen for immediate consideration as giving the maximum *total* inductance is marked black, the remaining spool sides, which are simultaneously short-circuited, being shaded. If one situation or section gives a higher slot inductance but a lower value for the surface-of-the-core inductance, it is obvious that the required situation cannot be accurately determined without a knowledge of the relative values of the slot and surface permeances as dependent upon the depth of slot and length of core; yet the uncertainty thereby introduced hardly needs to be taken into account in calculations of a confessedly approximate nature. A few remarks on the several classes as illustrated by Fig. 10 may in passing be made.

Class IA, $\frac{N_2}{2p}$ a whole number, and the number of slots also divisible by $2p$. With diametric, long or short-chord winding of this class, as in the ordinary lap-wound drum, so long as the maximum number s of sections simultaneously short-circuited by a brush is $\leqq \frac{kn}{2}$, the number of sectors corresponding to a slot (kn being the number of spool sides per slot), the inductance, self and mutual, is simply s times the value which it has when only one section is short-circuited at each brush. But as soon as the short-circuited spool sides in each zone spread beyond the limits of a single slot, the inductance is no longer proportional to s, the slot portion remaining constant and the surface portion rising less than in proportion.

With diametric winding, the rear pitch reckoned in spool sides is $y_r = \frac{kn \times slots}{2p} + 1$; but with very long chord winding under this class when the number of sections is a multiple of the number of slots, i. e., with more than two spool sides per slot, there are

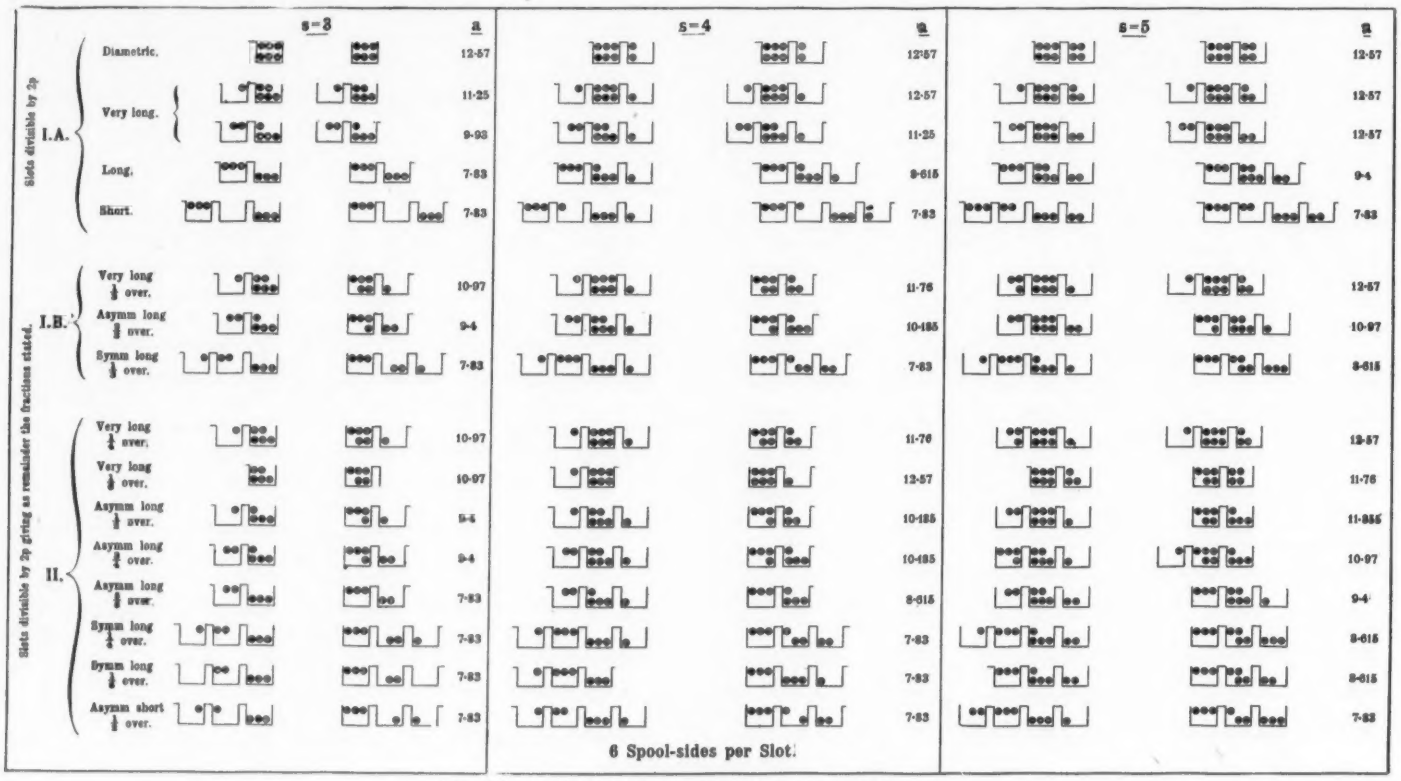


FIG. 10.—SIX SPOOL SIDES PER SLOT $s = 3$, 4 OR 5.

layers as shown in Figs. 4-9, their exact position therein is material for our present purpose.

I. CALCULATION OF $L + \Sigma M$.

4. *Diagram of short-circuited wires for ordinary brush widths.*

After thus defining the various windings by means of the as- evidently different degrees possible, according to the amount by which kn exceeds 2. Thus if $kn = 4$, there is only one case, when one side of an element occupies the right lower half and the other side the left upper half of a slot. Such a case has the advantage that the angle of advance of the center line of two adjoining spools exactly corresponds to that of the commutator sectors to which they are

connected; hence their reversing e.m.f. is precisely similar, and the method is on this account favorably noticed by Prof. Arnold.‡ But although easily applied to bar armatures, it is, in the case of coils, accompanied by the disadvantage that two widths of coil are required, so that their resistance and inductance becomes dissimilar. The more usual arrangement with similar coils gives the same resistance to them, but different reversing e.m.f's and inductances, according to their positions in the slot. If $kn = 6$, there are two degrees when the rear pitch measured in spool sides is respectively

$$\frac{kn \times slots}{2p} - 1 \text{ (as in the preceding case)} \quad \text{and} \quad \frac{kn \times slots}{2p} - 3;$$ if

$kn = 8$, there are three degrees, and so on.

Thus very long chord winding under class (*IA*) is closely analogous to diametric winding under class (*IB*); and the same divergences arise from true diametric winding when the number of simultaneously short-circuited sections is increased. For any given value of the brush width, the degrees of very long chord winding form a complete series of intermediate cases by which we pass in steps from diametric to long chord, and in precisely the same way the passage might be made from long to short chord, although this is not shown in the diagrams.

The Relative Reliability of Wireless and Wire Telegraph Systems.

By Reginald A. Fessenden.

WIRELESS telegraphy has now been in operation for some time and the question of reliability under certain conditions is one which might now be said to be definitely settled. The following results of tests during the years of 1900, 1901, 1902 and 1903 may be of interest:

In 1900 and 1901 a wireless system was in operation between Cape Hatteras and Manteo, Roanoke Island. The masts were 150 ft. high. This system was paralleled by an ordinary wire line and a telephone line.

Both telegraph and telephone lines were interrupted a great many times by storms. It is evident, however, that both lines must be put out of action at the same time to prevent communication, as when only one line is down messages can be transmitted partly by telegraph and the rest by telephone, or visa versa. In spite of this fact, there were twenty-seven days during which no messages could be transmitted by the wire telegraph or telephone lines.

During all this time there was not a single day during which messages could not have been sent by the wireless system had there been a permanent force of operators. In the early working of the system no trouble was experienced from atmospheric disturbances, they not being severe enough to prevent working. In the spring of the following year a series of very violent disturbances were experienced during certain portions of the day, which burned out the receivers then used, but as soon as a sharply selective system was applied this difficulty was overcome and the form of receivers then used has since been superseded by one much more sensitive and not subject to burn out. In passing it may be mentioned that the liability to destruction of the receiver is really a matter of no importance, because unless a system is sufficiently selective to cut out atmospheric disturbances it is only capable of limited use.

During the following year stations were established at Cape Charles City, Fortress Monroe and Ocean View. The masts were 50 ft. high and the distances 25 and 28 miles respectively. During the year no interruptions were experienced with the wireless lines, while on the other hand on three occasions the wire lines and telephone lines were put out of business.

In this connection it should be mentioned that on several occasions the fuses were burned out of the telephone cables, thus showing that even underground lines are subject to interruptions from atmospheric disturbances. In this connection also attention might be called to General Greely's article in a recent magazine in which he pointed out that at the most critical moment during the campaign at Santiago the wire lines were put out of action for a considerable time by atmospheric disturbances, and that no news was received until after the naval battle in which Cervera's fleet was destroyed.

‡ Die Gleichstrommaschine, vol. i, p. 128.

As a sample of the condition of affairs during these storms, the following report will be of interest:

Fort Monroe, Va., May 25, 1903.

"In reply to your request for a statement of telegraph and telephone conditions at this place to-day, will say the following:

"After a severe rain, wind and lightning storm at 10 P. M. last night, the Postal Telegraph-Cable Company have no wires, turning over to the Western Union all their rush business and holding less important business pending the repairing of their lines.

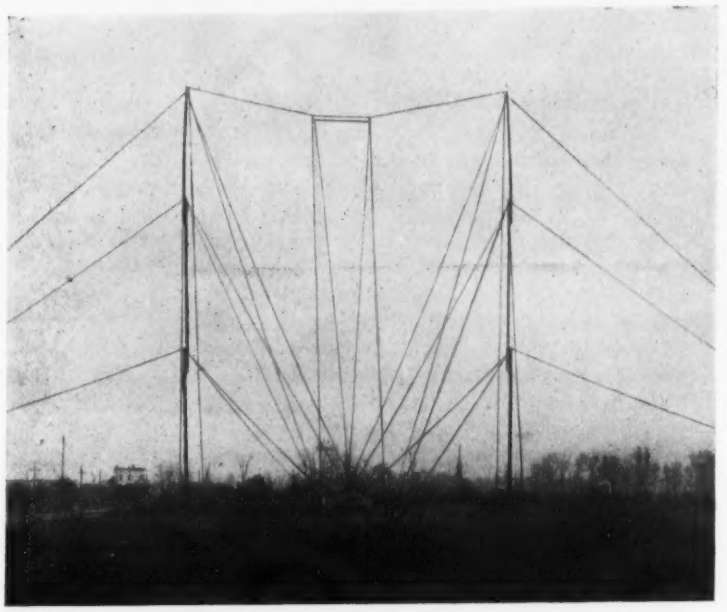
"The Southern Bell Telephone Company's exchange is completely isloated, having lost three land wires to Newport News, three cable circuits to Norfolk and six local circuits. With one exception, the last are all less than 400 ft. in length.

"The Southern States Telephone Company have also lost three or four cable circuits to Norfolk.

"I was at your station at 11 o'clock this morning and found your operator working with your Ocean View station with good results, none of your equipment or apparatus having sustained the slightest injury.

"The storm last night was of unusual severity, the wind being very high and accompanied by hard rain. The lightning flashes were very frequent and vivid."

During 1903 stations were erected between New York and Philadelphia, a distance of approximately 80 miles overland, the length of the verticals being 135 ft. Although these stations were working with only one-quarter of a horse-power of energy, the service has been quite satisfactory, 40 telegrams being sent and received daily during the hours devoted to practice. This is accomplished in spite of the fact that there are one hundred and thirty-five interfering stations both in New York and Philadelphia. Some very interesting results have been obtained as regards selectivity by the new methods used, and it has been found possible to turn on any station that is desired. Amongst other interesting points it was found possible to receive messages from the naval vessels at Oyster Bay, although on comparison with the messages sent by Brooklyn Navy Yard it was evident that the latter station did not succeed in obtaining communication with the ships. When it is considered that the messages received at Jersey City from Oyster Bay must have passed over the city of New York, with its numerous high buildings, the result must be considered very encouraging.



VIEW OF WIRELESS TELEGRAPH STATION.

Another interesting point is the fact that the news from the yacht races was received at the Philadelphia station, and that it was found that that station could select whatever sending station was desired to the absolute exclusion of all others. The Marconi messages, however, could not be deciphered as almost all of them were in cipher. A great deal of objectionable matter was received, some of such a character that the operators declined to take it down.

The most interesting point, however, in this connection is that, although several storms have visited the neighborhood, some of them with severe atmospheric effects, in no case has it been found neces-

sary to stop work, except during a severe rainstorm, when the noise of the rain on the roof of the shed made it difficult to hear. In a suitable building this would not, of course, occur.

During the great storm of last month the writer was in Washington and desired to communicate with the Jersey City station. It was learned that the lines were working as far as Philadelphia, but that messages were delayed beyond there. The Philadelphia station was, therefore, telegraphed to and a report as to the condition of the Jersey City station was promptly sent back to us within a couple of hours.

These results, extending over a considerable number of years, seem to show that so far as reliability goes wireless telegraphy is superior to the ordinary wire lines. The fact may be definitely stated that aside from any future developments there is, at the present time, no condition of weather under which messages cannot be transmitted. Even thunderstorms of the greatest intensity, i. e., so strong that sparks can be drawn from the vertical do not prevent the transmission of messages, although occasionally a word will be lost.

The stations between New York and Philadelphia were constructed to test the effects of summer droughts and winter weather. It was anticipated that some difficulty might be met with during long droughts in the summer and zero weather in winter. The result of the tests, however, shows that with a properly-constructed wave chute no difficulty is obtained in transmitting messages during the dry spells. As the navy, from the result of its tests last winter between Washington and Annapolis found that the transmission was easier in winter than in summer, it is possible that the absence of sap from the trees may more than compensate for the freezing of the surface water, and that the cold will not prove a serious obstacle. In any case by next spring the data derived from the operation of these experimental stations will enable us to accurately design for any desired transmission.

During these experiments a curious and unexpected advantage of telephone receiving over instrumental receiving developed. While nearby stations, such as that at Coney Island, were easily cut out so as to be almost or quite inaudible at the New York station, attempts were made several times by parties in the near neighborhood to interfere with the work. Here the curious phenomena developed that if the interfering impulses were *strengthened* and the Philadelphia signals *weakened* the reading of the messages was quite easy. This phenomenon is possibly akin to that of the old lady who could only hear when a drum was beating, or, more probably, shows that if the *difference* in intensity is sufficiently great, within limits, both sounds are readily separated.

Since the above was written, the records of all messages sent between the New York and Philadelphia stations during the past two months have been carefully examined with a view to ascertaining what percentage of messages had to be repeated.

The records show a steady and uniform improvement. Previous to the time mentioned fully half the messages had to be repeated, but at the beginning of the two months the percentage of repeated messages had decreased to 5 per cent., partly on account of the signals being stronger, and tuning better, while during last month the average was not more than 2 per cent., and in many cases several hundred messages were sent without a single repeat.

As one of the operators points out, in making his report, this is really better than the average work on wire lines, especially since the average rate of transmission was between twenty-five and thirty-five words per minute, which is a high speed, even for wire lines. It should be said that on account of the character of the messages transmitted, many being in cable code or foreign languages, it was possible to send very little Phillips code, so that the speed represents practically nothing but regular Morse. Of course, in talking between stations outside of the hours devoted to practice, the operators use the regular operators' code and higher speeds are reached.

An Improved Method of Testing Large Alternators Under Full Load Conditions—II. (*Concluded.*)

BY B. A. BEHREND.

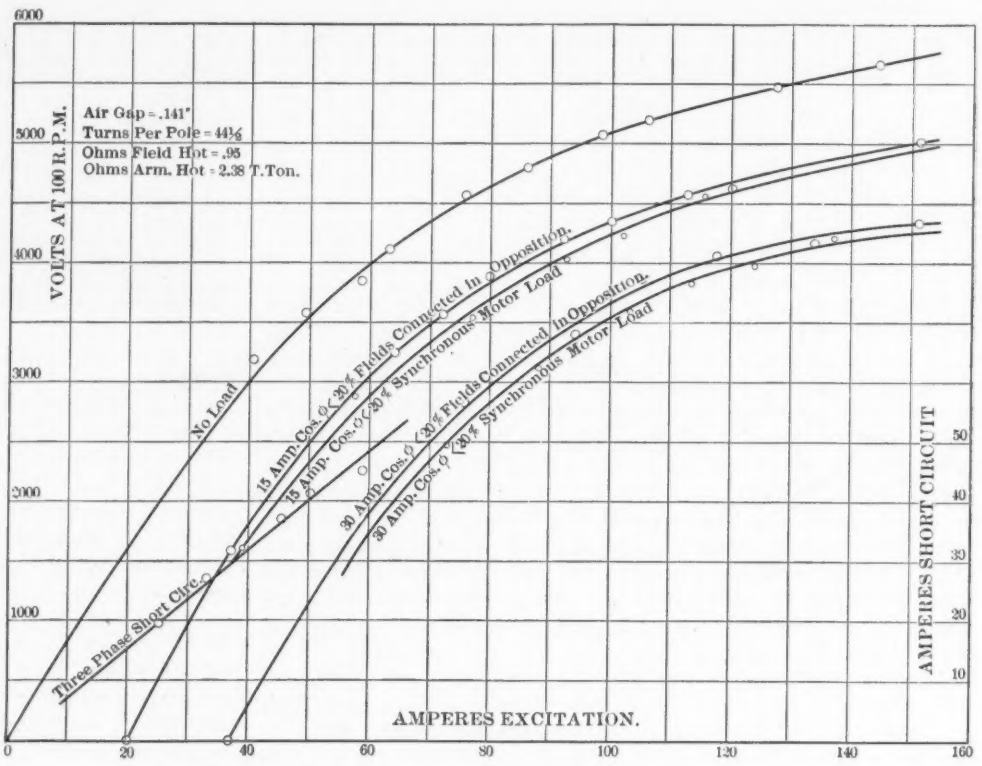
The improved method of testing alternators by circulating power can be used to carry out with great accuracy all the tests that have to be performed in order to know the characteristics of the machine.

DETERMINATION OF HEATING.

It is evident that the heating of the armature coils and of the field coils can be tested accurately as regards the C^2R loss, as full load current can be made to circulate through the armature coils and also full load current is carried by half the number of poles. It is not so obvious that the core loss of the machine is the same as under normal load conditions. Considering that the loss through hysteresis and eddy currents depends on the maximum inductions, between which the cycle of magnetization takes place, it appears resonable to assume that the core loss with the fields in opposition according to the new method here described is dependent only on the induction produced by the poles which act as generator. In order to ascertain this point experimentally and to dispel any doubts in regard to it, tests were made on two machines, first determining the core loss with the coils all connected in series, secondly with the coils connected in opposition, and a complete agreement was found between these two tests. It has thus become an experimental fact that the individual losses are the same in case the generator is carrying its full rated load under normal conditions or under the conditions as described in this paper. The method is, therefore, immediately available as the simplest possible form for the determination of the temperature rise for any part of the machine, a test which is extraordinarily cumbersome on large units if carried out in the usual manner.

DETERMINATION OF REGULATION OF ALTERNATORS.

In order to check the reliability of the method for the determination of the regulation of alternators at a low power factor, the following tests were made: A 72-pole alternator was operated as a generator on an under-excited synchronous motor and a load saturation was taken for different currents, as described at length in my paper read before the Institute in May, 1903. The alternator was then operated upon itself by exciting thirty-six poles with a large current and the other thirty-six poles with a weak current, and by computing from the short-circuit current, and the exciting current in the thirty-six poles that act as motor, the terminal voltage of the machine, a set of curves was plotted. The curves obtained by the former method lie slightly lower than the curves obtained by the



REGULATION AND SATURATION THREE-PHASE, 3800 VOLTS, 100 R.P.M.

latter method, which is due to the exceptionally large local fields in the machine experimented on, which was a 72-pole machine, the pole pitch being extraordinarily small on account of the small output and low speed of the machine. For this reason the generator was particularly fitted to test the method in regard to its accuracy. In both cases the power factor was very low, practically zero, or at least equivalent to a zero power factor as far as regulation is concerned. This method, therefore, yields at once the most simple way of determining the regulation of alternators on a power factor zero, and it is, therefore, the most natural way of determining the regulation in alternators. In my paper before the Institute, I recommended that the regulation of alternators should be tested on a power factor zero, and we, therefore, have now the means of so doing without incurring the slightest difficulty.

New Generating Station of the Rochester Gas and Electric Company.

The strategic situation at Rochester, N. Y., with respect to power for electrical generation is at the lower falls of the Genesee, which are 96 ft. high. The level of the river above the falls is about 124 ft. below the general level at the top of the high bank, the upper level of the river being thus nearly midway between the street level and the level of the river at the foot of the falls.

In order to fully appreciate the strategic situation, it should be understood that the Genesee River has a fall of 255 ft. within the city limits. This difference in level is utilized, first, by a dam at Court Street of 16 ft.; second, by a dam just above the upper falls of the Genesee about 95 ft. high; third, by the middle falls of the Genesee, nearly 30 ft. high; and finally by the lower falls of the Genesee.

Of the power of these several falls, the Rochester Gas & Electric Company by virtue of the ownership of original and inalienable water rights, which have been held to have all the attributes of real estate, controls in the neighborhood of 90 per cent. The company owns absolutely all of the water rights at the lower falls, where the water reaches the middle falls of Lake Ontario, and the remaining rights are well distributed on the races supplied from the dam at the upper falls and the dam at Court Street. It will thus be seen that the term "strategic advantage" is used advisedly in regard to the lower falls.

Necessarily after having done its work at the Court Street dam, the upper falls, and the middle falls, the water must be available at the lower and last fall of the Genesee River. It was this consideration that doubtless formed the principal factor in the erection of the important water power plant of the Rochester Gas & Electric Company at the lower falls, which is the subject of this article. Before undertaking the recent improvements at the lower falls, station No. 5 was a very large factor in the street lighting department of the company's business. It had, and still has, at the station at the foot of the lower falls, 31 Brush arc light dynamos, three 100-kw, 550-volt direct-current dynamos; two 70-kw, single-phase alternating-current generators operating at 1,100 volts, and two 100-kw and one 175-kw Edison machines. These are driven by fourteen turbines from two separate penstocks.

For the past two years work has been in progress having in view the greater utilization of the important water power at the lower falls. A new power house 47 x 90 ft. and 47 ft. high was constructed on concrete foundations placed in the rock at the river bottom at the foot of the lower falls. This power house is so constructed that it can be extended to the eastward towards the high bank of the river and its present proportions duplicated. At the outset the perpendicular fall of the escarpment was faced with concrete. The forebay was so enlarged so as to give a rock length of 80 ft. and at its westward or river end the rock was ballasted out, giving a depth of water at the new intake of 17 ft. In addition the dam was strengthened in order to avoid damage by spring freshets.

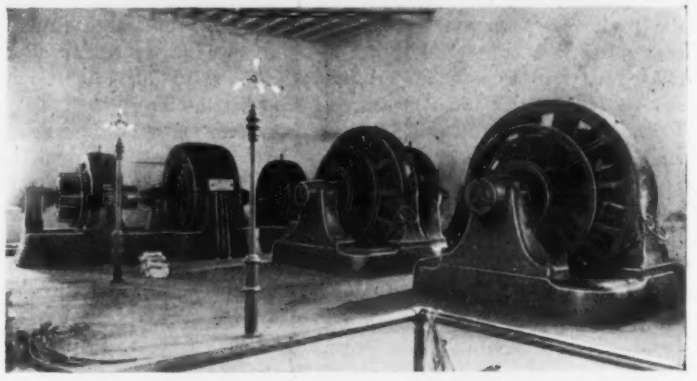


FIG. 2.—INTERIOR VIEW OF STATION.

From the forebay extend two penstocks 11 ft. in diameter, of which but one is as yet utilized. After covering over the brink of the fall it has a perpendicular descent to a point under the concrete floor of the power station, of 94 ft. and 6 in. Again curving it extends under the concrete floor a distance of 75 ft. It is constructed of steel 5/8 in. thick. The waste is through a tailrace 14 ft. deep with concrete flooring. This penstock supplies two Trump wheels of 2,200 hp, 42 in. in diameter, with 96 in. opening from penstock. They are each controlled by a Sturges governor, which has been found by actual practice to vary only 2½ per cent. from full load to no load. By an ingenious arrangement peculiar to this type of governor, the fly-wheels are brought to speed before the wheel. The speed of the fly-ball is similarly reduced before the speed of the wheel, this securing very close regulation. The fly-wheels are thus regulated by the velocity of the water. The governors are 50 x 32 in.

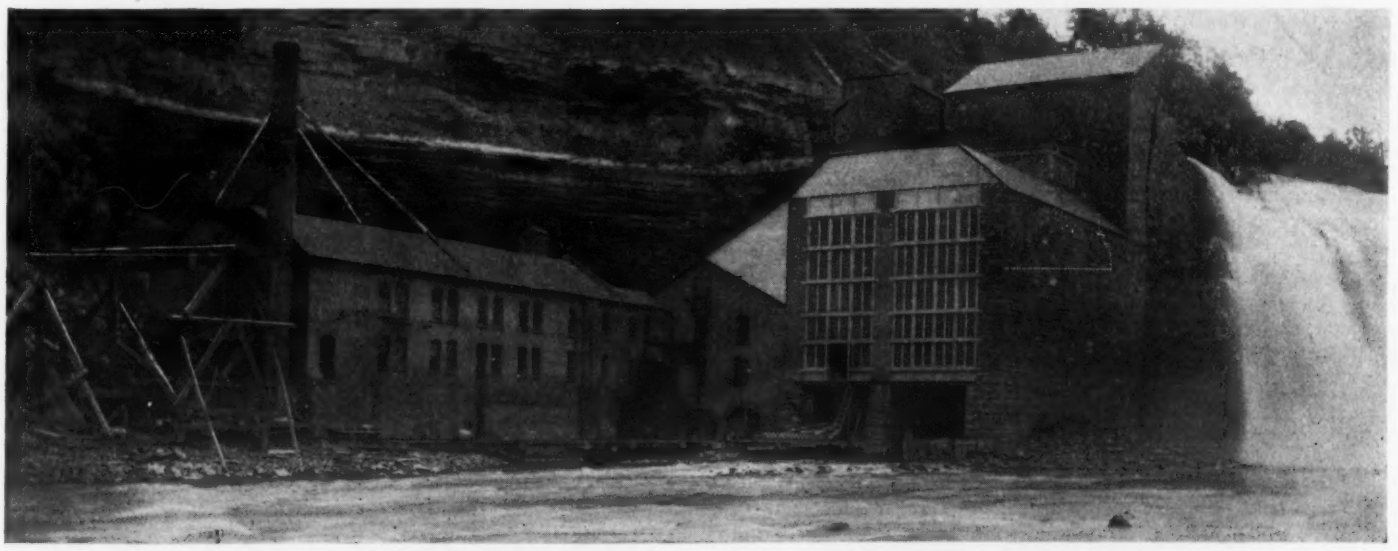


FIG. 1.—NEW GENERATING STATION AT LOWER FALLS OF THE GENESEE, ROCHESTER.

On the shaft of each of the turbines is a General Electric 1,200-kw, three-phase revolving field, alternating-current generator. It has 22 field pieces. The speed is 327 r.p.m. at 60 cycles, generating a current of 144 amp. under normal load at a terminal pressure of 4,150 volts. Since September 20 one of these generators has been

in operation night and day without stopping, and has frequently been subjected to an overload of 35 per cent. for three hours. The exciter is at the extreme end of the shaft and is a multipolar machine giving 144 amp. at the speed of 327 r.p.m. under a potential of 125 volts. The station is furnished with a traveling crane of 25-tons capacity. The arrangements of the power station are such that this equipment of water pressure, turbines and generators can be doubled when desired.

The switchboard is situated on a gallery or pulpit on the falls side of the power house. The equipment is for a four-wire, three-phase system. Each lead is equipped with ammeter, voltmeter and a time limit relay, which breaks in oil and lights pilot lamps. There is an ammeter and kilowattmeter on each phase and a voltmeter on each panel which can be operated on each phase. The current is fed to bus-bars with separate panels on the switchboard for each machine and each set of feeders. There are also separate single-phase feeders, which are also equipped with a time-limit relay. There is also an ammeter and voltmeter in each single-phase panel.

The feed wires are carried up the face of the power house next to the falls, where they enter conduits forming part of the race wall and are carried up the high bank, where they enter the underground conduit system. The latter work is being pushed rapidly to completion and in a short time the overhead wires will entirely disappear.

It will be thus seen that the possibilities of power distribution from the lower falls station of the company are very great. In fact, current is now being distributed to the uptown stations in large quantities. It is the opinion of those who have made a close study of the power situation in Rochester that the officials of the Rochester

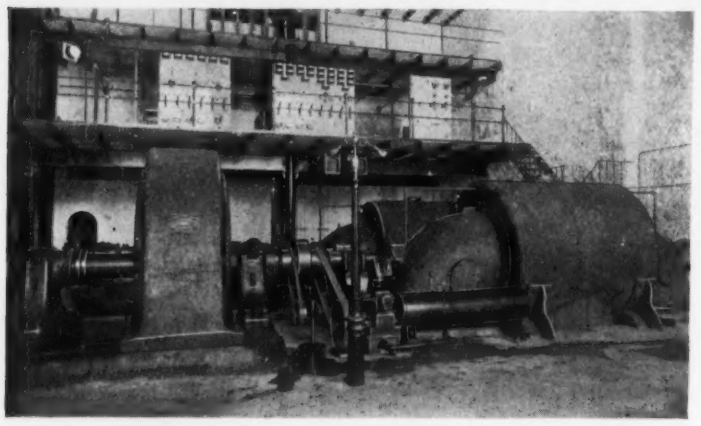


FIG. 3.—VIEW OF WATER WHEEL, GENERATOR AND SWITCHBOARD.

Gas & Electric Company have shown wise foresight and good business management in making the comparatively large outlay involved in the building and equipment of what is considered to be the most economical and profitable power plant in the State.

The main transformers station is situated on North Water Street in the exact center of the commercial district of the city of Rochester and is a stone building absolutely fire-proof. At present there are one Stanley 550-kw, two General Electric 500-kw and one Stanley 100-kw motor-generator sets with room for three more of 550 kw and ample switchboard capacity for the latter. The above-mentioned work has been done under the supervision of G. A. Redman, superintendent of the electric department.

American Rates for Current.

The National Electric Light Association, following up its useful work of special bulletins on features of lighting and power service, several of which have already been printed, has just issued its first bulletin of rates for lighting and power service, and covering statistics from a great many hundreds of companies scattered all over the country. For a first issue this is remarkably well done, and there are several features of value that must be commended. In every case the population of the community is given and then the rates are quoted for arc lighting, incandescent lighting and power. There is also a column for remarks, under which a great many interesting details are furnished. Such a pamphlet as this must prove very interesting and valuable to all the members of the association, and Mr. E. H. Davis, the secretary, is to be congratulated upon the good work done by his office in this compilation.

Trolley Traction on the Miami Canal.

The Miami and Erie Canal in the State of Ohio has recently been equipped with electric traction by the Miami & Erie Canal Transportation Company, the work being done by the Cleveland Construction Company, of Akron, Ohio. The section now in operation extends from Cincinnati to Middletown, a distance of about 42 miles. Current for this section is at present taken from the lines of the

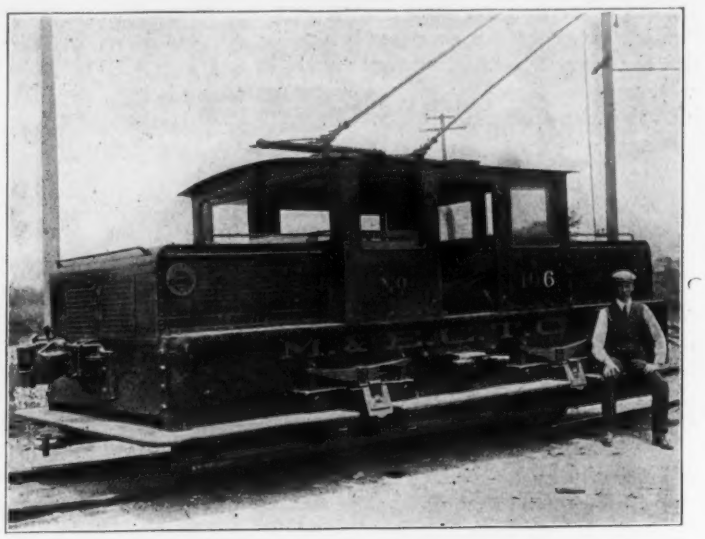


FIG. 1.—STANDARD CANAL LOCOMOTIVE.

Cincinnati Gas & Electric Company as 4,200-volt, 60-cycle, three-phase current, received in a motor-generator station, which changes the frequency to 25 and separates the haulage system from the local lighting and power system. Part of the output, at 390 volts, feeds directly the first section of working conductors. The remainder is stepped up to 33,000 volts, and transmitted along the canal bank. At four reducing stations transformers receive the 33,000-volt current and deliver it to the working conductors at 1,170 volts. The locomotive receives this current and transforms it to 390 volts for use

FIG. 2.—VIEW ALONG CANAL, SHOWING LINE AND TRACK.

in the motors. There are two trolley wires of the grooved No. 0000 type, the track serving as the third conductor. This plan differs greatly from others, one notable feature being the use of a locomotive on a track along the canal bank and another important item being the application of the three-phase current.

The locomotive shown herewith in Fig. 1 is of compact type and

weighs 55,000 pounds. It has four 33-in. wheels mounted on 6-in. axles with 5-in. journals, and to each axle is geared with double reduction an 80-hp, three-phase induction. These two motors are normally operated in tandem. The primary winding of the first motor is connected to the transformer secondaries, its secondary winding to the primary of the second motor, and the armature of this last is closed through a controller and a set of iron-grid resistances. This controller serves for reversal and speed variation when required, although the motors in tandem are designed to give the 3 mph to which the speed is, at present, limited by statute. In this normal operation the motors give 40 hp each, and a horizontal effort with 25 per cent. coefficient of adhesion of 9,600 pounds. The locomotives have not only hooks for making fast the towing cable, but couplers for the direct haulage of freight cars whenever desirable. As the track is well laid with 70-pound rails such haulage is quite feasible.

The seven locomotives were built by the Baldwin Works; the electrical equipment by the Westinghouse Company. The locomotive side frames consist of very heavy cast girders of channel section, framed across at the ends with similar castings. The axles are 6 in. in diameter with 5-in. journals, and the wheels are 33 in. in diameter, of standard railroad pattern, with 1¼-in. flanges and 4-in. tread. At

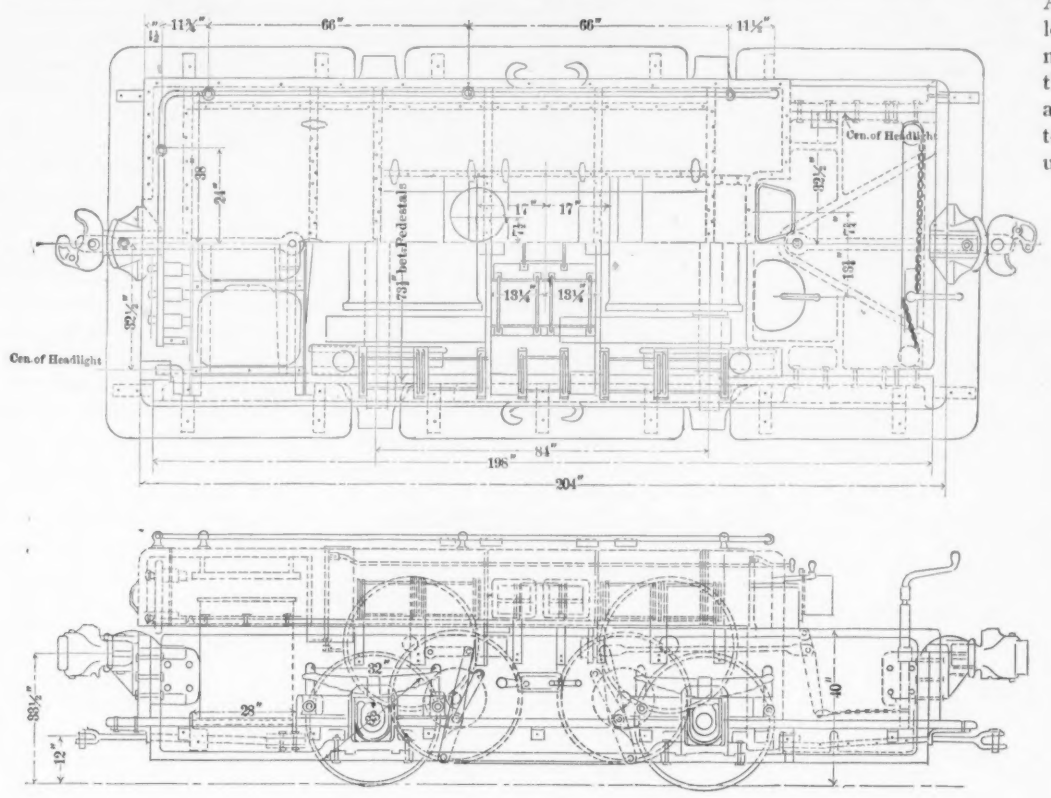


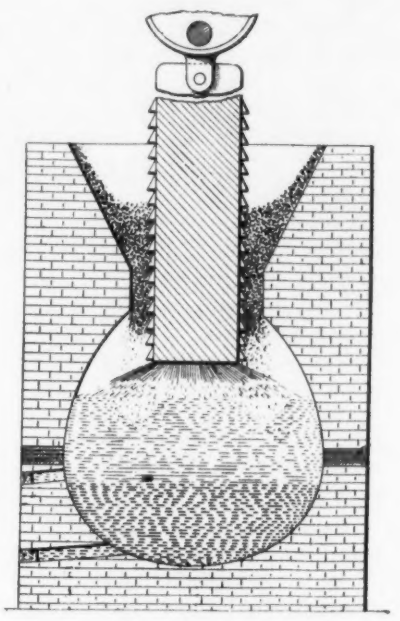
FIG. 3.—PLAN AND SECTIONS OF SWITCHING LOCOMOTIVE.

tons, but in the present condition of the canal bed it is seldom practicable to load deeper than 30 in., at which they carry about 50 tons of freight. The transportation company has about twenty serviceable boats, acquired with a canal packet company which was purchased and has building facilities for the needed increase of its fleet. A telephone line for dispatching, etc., is also operated.

Recent Electrochemical Developments.

ELECTROMETALLURGY.

A patent was granted on November 3 to Prof. William S. Franklin, of Lehigh University, for the electric furnace shown below. A masonry structure contains a pear-shaped chamber communicating at its upper end with a short cylindrical passage, which opens into a flaring mouth. The lower portion of the hearth of the furnace is covered with a layer of carbon, which is connected by means of a metallic rod passing through the masonry structure with one pole of the source of current. A rod of carbon or metal which forms the other electrode is suspended into the top of the furnace. It is provided with downwardly-inclined teeth. The material to be acted upon is fed into the furnace by the reciprocation of the carbon rod. As the latter descends, the horizontal lower surfaces of the teeth engage the material and carry it downward. When the carbon rises both the action of gravity and the inclined upper surface of the teeth facilitate the passage of the teeth upward through the material without



ELECTRIC FURNACE.

the extreme forward end of each locomotive is the plug switchboard, behind that the transformers, then one motor, then the cab, with the controllers, then the second motor and behind that the rheostat, which fills up the rest of the space. The locomotives are 14 ft. long, 8 ft. 4 in. wide and have a wheel base of 7 ft.

The extreme height of the standard locomotives was limited to 8 ft. 6 in. by the bridges and the extreme height of the switching locomotive, to be used at the southerly end of the line in Cincinnati, was made only 5 ft. 6 in. In this last, to save head room, the cab was omitted, and a cockpit provided for the motorman at the rear end, as in common practice with mining locomotives. The height of the trolley wires above the rail varies from 6 ft. under some bridges in Cincinnati to 22 ft. over railroad crossings, and is ordinarily 18 ft. Under the bridges north of the first half mile in Cincinnati the minimum height of the trolley wire is 9 ft.

The standard boat is 80½ ft. long exclusive of rudder, 13½ ft. wide and 9 ft. high, measured over all. Most of the boats are decked, leaving a clear height of 7 ft. 8 in. in the hold. There are some open boats for coal, gravel, empty barrels and other coarse and bulky freight. Loaded to a draft of 3 ft. such boats can carry about 65

raising the latter, so that on the next downward stretch a fresh quantity of material is fed.

The first application of this furnace, described by the inventor, is to the reduction of iron ore. For this purpose the hearth of the furnace is first filled to a certain height with slag and the current is started. If the carbon rod dips into the slag the heat developed is altogether Joulean heat. If the carbon rod is raised above the slag, there is added to this the heat of the electric arc formed between the lower end of the rod and the slag. If then the iron ore is fed into the furnace through the mouth, it is reduced during its descent by the heat of the molten slag and the arc. When the ore reaches the intensely hot slag it melts and filters through the slag to the bottom of the receptacle, where it collects. The iron is drawn off through a tap hole in the bottom of the furnace, while the slag is kept at the proper level through a tap hole at a higher level.

Another application of the furnace is for the manufacture of glass. In this case the inventor uses glass itself for the first filling of the hearth, instead of the slag in the former example. The raw materials from which the glass is to be formed are fed through the mouth. They become heated as they descend until when they reach the

surface of the intensely hot molten glass they are fused and form glass. Only one tap hole is here, of course, required.

A patent was granted on November 3 to Messrs. Oliver W. Brown and William F. Oesterle for the reduction of zinc from its sulphides (blended). The advantages of the process are said to be that the usual preliminary roasting is dispensed with, and that valuable by-products are obtained in the form of calcium carbide and carbon disulphide. The description of the process is rather short, but the gist of it is as follows: The inventors mix carbon (coke or coal) with zinc-blende in a certain proportion and subject the mixture in an electric furnace to a heat "sufficiently high to produce the products desired." The zinc is reduced to metallic form and volatilized out and is condensed in the usual way, while the carbon, calcium and sulphur form calcium carbid and carbon disulphide.

MERCURY CATHODE PROCESS FOR ELECTROLYSIS OF BRINE.

While the Castner-Kellner process is at present the only mercury cathode process in actual operation on a large scale, there has been for some time a tendency toward intrenching on this monopoly. The only feature which appears to distinguish new processes of this kind from the Castner-Kellner process is the method by which the amalgam is removed from contact with the electrolyte and a fresh mercury surface is provided. We referred some time ago in these columns to the Bell process experimented with by the Pennsylvania Salt Manufacturing Company, and we have before us a patent, granted on November 3, to Mr. E. Hannon and assigned to the Solvay Process Company. In the process of Hannon the mercury cathode is at the bottom in connection with a basin containing pure mercury, while an overflow is provided by which the amalgam formed at the top of the mercury cathode (where it is in contact with the electrolyte), may run into another basin. By pressure from the first basin new mercury flows into the lower portion of the mercury cathode, and the amalgam formed in the upper part is caused to flow off continually, so that a fresh surface of mercury next to the electrolyte is continually provided.

BATTERY INVENTION.

A patent granted on November 3 to Mr. G. H. Rabenalt and assigned to the Gould Storage Battery Company relates to a construction of battery grid, to insure compactness and large active surface. The grid comprises outside bars, intermediate bars dividing it into a number of compartments, and relatively thin anchoring devices, which bridge these compartments and are provided with projecting bars, imbedded in the active material.

Another patent for an accumulator grid was granted on November 3 to Mr. J. von der Poppenburg. It comprises a non-conducting frame and a conductor grating provided with bendable arms which have interlocking connection with the frame.

Mr. H. P. Maxim has patented improvements in charging apparatus for automobile accumulators. The current available is generally not suitable for charging the batteries so that a motor-generator is required to give the proper charging current. There are dangers in this arrangement in so far as the current may fail in the motor circuit, and thus cause the generator to be run from the battery as a motor, the battery being discharged. The motor-generator may also continue to run after the battery has been fully charged, or a sudden overload may occur on either the generator or the motor. To provide against injuries from such causes, Mr. Maxim provides overload and underload interrupting means in the supply circuit, and overload, underload and overvoltage interrupting means in the circuit between motor-generator and battery.

A patent granted on November 3 to Messrs. G. Schauli and D. Loewenstein relates to a dry battery which has some new features of mechanical construction, while its main feature is that the filling mass between the zinc electrode and the depolarizing material surrounding the other electrode is formed by steeping raw rice in water until there is a partial formation of malt and then boiling it with a little water down to the consistency of syrup, after which the salts of the electrolytes are added to the hot mass.

Two patents granted to Mr. J. W. Gladstone refer to primary batteries, the new features being essentially mechanical details. Three patents granted to Mr. H. Halsey relate to mechanical details of the class of primary battery which this inventor is developing, and in which polarization is counteracted by the well-known means of a relative movement of the electrolyte and polarizable electrode.

New Telephone Patents.

NEW LOCKING DROP.

For bridging or branch terminal working, wherein the subscriber's line drop on a multiple switchboard is permanently connected to the line wiring irrespective of all jack contacts, the necessity of using a locking line drop is almost self-evident; for were not a locking up of the armature during the existence of a call provided, the answering operator of any line would be called in one or more times during each incoming call. Even with the locking drop some disturbance is made in front of the answering operator of a line receiving a call each time alternating signal current is put upon the line, unless some special means is provided to prevent it. The disturbing noise referred to is the rattle of the drop shutter hook and is prevented by causing the locking device to secure not only the drop shutter, but the hook also.

The latest idea in locking drop is the subject of a patent recently issued to H. P. Claussen, of Chicago, and assigned by him to the American Electric Telephone Company. The drop is provided with separate line and locking coils disposed front and back upon the same center line. The hook-raising armature pivots between and beneath the opposed coil faces and may be attracted by either one, the pulling power of the locking coil under normal excitation, however, far outweighing that of the line coil. When a line signal passes and the locking coil circuit is open in the jacks, the armature approaches the line coil and releases the shutter. After a plug has been inserted in a line jack and the locking coil circuit closed, the hook armature is held against all influence of the line coil, and in addition, as a safety measure, the drop shutter being of magnetic material, is held magnetically against the front face of the locking coil.

A TELEPHONE "SQUAWKER."

Telephone subscriber signals, since the passage of the attempts to call by means of abnormal receiver excitation, have been almost universally by means of bells, these having been provided with different sorts of gongs where the sound must be made distinctive. Round gongs, slit gongs, English chime gongs, sleigh and cow bells and even gongs of black walnut have been used. Every one has, however, depended in the end upon bells. In the patent issue of October 27, however, a new suggestion is brought forward by R. H. Ferguson, of Philadelphia, in a device which may be termed a telephone "squawker." This device has an electromagnet, the armature of which, through a linkage, operates two miniature bellows. These each feed a separate reed with resonating pipe to give a toot on each pipe for every stroke of the armature.

TELEPHONE BRACKETS.

With the increasing use of telephone desk stand sets and of roll-top desks, telephone subscribers are being more and more impressed with the fact that these two are at times an awkward combination, it being usually necessary to use one slide for the telephone, as to put it within the desk renders it awkward to answer calls; and in the exposed position on a desk slide the telephone set is exposed to a

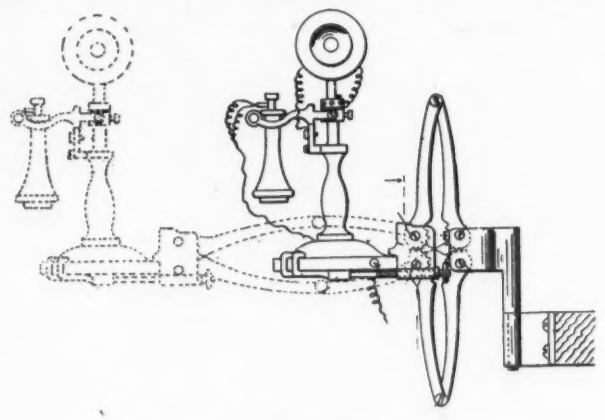


FIG. 1.—SIEGFRIED FOLDING BRACKET.

maximum of wear and tear from being knocked over and at times dropped even on the floor. To meet the emergency of late, several types of holder have appeared, and it is one of these brackets, a patent for which has been granted to S. J. Siegfried, of Chicago, that is shown with a desk stand set in position in Fig. 1. As indicated, the telephone may be swung about a vertical axis and may occupy any position from that shown in the full lines to that shown in the

dotted lines. The construction of the arms with intermeshing gear teeth shows that the bracket will remain of itself in any intermediate or the extreme position. The desk stand is carried in a three-prong clamp and thereby held securely to the bracket.

Another telephone bracket, but one of an entirely different sort, and for an entirely different purpose, is the subject of a patent issued to G. W. Ganoe, of Philipsburg, Pa. This bracket is a receiver holder designed to hold the receiver to the ear during use. It has an automatic hook switch attachment, and as a point of novelty is carried by the transmitter arm and thereby automatically subject to adjustment for the different heighths of persons with this latter.

BRIDGING LINE SPLICER.

The method of splicing a bridge tap to a party line subscriber's line has been the subject of much consideration in the past. With hard-drawn copper line wire, good practice demands a sleeve joint which will not injure the skin of the wire, and yet every suitable splicing sleeve on the market requires that the line wire be cut in order to make the tap, the whole process resulting, therefore, in two splices. Fig. 2 shows a recently-patented tapping connector, which seems to overcome all difficulties. The sleeve of this connector is slotted from end to end and is made up with a slight taper. A plug

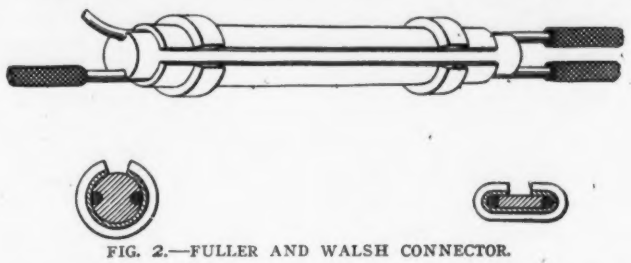


FIG. 2.—FULLER AND WALSH CONNECTOR.

of conducting material grooved to take the sizes of wires to be used and given the same taper slides within the sleeve. In making the splice the line wire is threaded into the sleeve, the tap wire is then inserted and the plug forced home, each wire lying in its own groove and tightly gripped by the resilient sleeve. It is evident that the splice may at any time be removed without injury to the main line wire. It would seem that the oval form shown in the lower left-hand corner of the figure will be the more serviceable one. The inventors of this connector are F. P. Fuller and J. J. Walsh, New York and Yonkers, respectively.

ELECTRICAL DIVERTER.

"Electrical diverter" seems a rather novel name for a telephone lightning and heavy current protector, but it is the one selected as the title of a patent for such a device invented by A. C. Gilgen, of St. Louis, and assigned by him to the Central Telephone & Electric Company. The essential parts of the protector is a rectangular sectioned mica strip with terminals of metal mounted thereon, between which latter a piece of fine copper wire extends. This wire is spiraled about the mica and secured to the terminals by fusible alloy. The protector is normally in series with the line to be protected, and is held in clips near to a ground plate. The theory of action is that lightning upon the line will be forced off to the ground plate, probably by inductive action, while any excessive current will cause the copper wire to free itself from the fusible alloy.

ANTISEPTIC MOUTHPIECE.

After the routine antiseptic mouthpiece and sheet-of-paper-protector-patent boom it is a pleasure to find a distinctly new idea for the disinfecting of telephone apparatus irrespective of whether disinfection is or is not necessary. That this idea is novel probably none can dispute; but whether the cure may not be worse than the disease in at least some instances, we leave the reader to decide.

The device to be considered is described in a patent just issued to N. J. Tubbs, of Louisville, Ky., and consists of an automatic hot-air furnace under control of the telephone hook switch. The furnace thus becomes automatic in its action. The fuel is gas supplied to the burner through a flexible tube. A cock is, of course, interposed between the supply and burner, this cock being opened by the descent of the hook switch and closed by a mercury thermostat. The ignition of the gas is also controlled by the switch hook, this causing one from a coiled strip of percussion caps to be passed on to an anvil and to be struck off by a small hammer. Immediately beneath the receiver mouthpiece, as the receiver hangs on the hook, is a radiating surface exposed to the heat of the gas flame, while a metal tube leads to the transmitter. The heat from the flame thus thoroughly heats up both these instruments immediately after use, and disinfects them. When they are hot enough, the thermostat works and the operation is complete.

So far so good. What will happen, however, when the cap fails, as it is sure to do, and the gas flows through the transmitter? Suppose a smoker arrives about this time? Again, if the thermostat fails to shut off the gas, mercury fumes will surely fill the transmitter while the exposed hot metal tube will be always ready to assure the telephone user that the telephone is being regularly disinfected.

TIE WIRE.

Tie wires for securing conductors to insulators have heretofore consisted of a short length of soft-drawn or annealed wire of a diameter approximating that of the wires to be secured. Of course, different methods of wrapping the tie have been used, such, for example, as the "telegraph tie" and the "telephone tie," but the simple straight tie wire has been sufficient. Recently, a considerable movement toward self-tying insulators has been made, but thus far with indifferent success. Now comes a "formed" tie wire, the subject of a patent granted to G. F. Moore, of Mobile, Ala. This tie wire is formed with a semi-circular mid-section to fit the insulator, and with crimped terminals. The crimps and mid-section all lie in a horizontal plane, and the line wire may be secured by bending it back and forth across the tie wire so that it interweaves with the tie wire crimps, taking itself at the same time a registering series of vertical crimps. At the extremities of the tie wire there occurs one crimp in the vertical plane which hooks on to the line wire to prevent it from freeing itself by swaying.

AN AUTOMATIC CUT-OUT.

An automatic cut-out to prevent the continued blow of an excessive current is the subject of a patent of the issue under consideration. The inventor of this cut-out is E. M. North, of Brooklyn, N. Y. The cut-out is thermostatic in operation, two bars normally in the circuit, expanding from being heated by excessive current, become deflected. This deflection through a linkage and contact arm cuts resistance in series with the line for a slight motion, and later cutting the bars from circuit and eventually opening the line. As the bars cool off and go back to their normal position, the normal connections become automatically re-established.

The Telephone Crisis in Paris.

It appears to be the practice in France for various members of the Chamber of Deputies to make reports on the items of receipts and expenditures which go to constitute the general budget, and in conformity with this practice a report on the postal telegraph and telephone services has been made for the year 1903 by M. Marcel Sembat. A very interesting portion of this report deals with what may be called the telephone crisis in Paris, and some of the observations made in regard thereto are of interest not only to telephone engineers in America, but to those engaged in the art throughout the world. Mr. Sembat notes the fact that the subscription rate in Paris is 400 francs, or $80, and that the administration had promised to reduce this flat rate to 300 francs, although nothing of the kind has been carried out. The flat rate in Paris allows an unlimited number of conversations with all subscribers within the Paris exchange proper and all within the municipal boundary of Paris, which embraces 48 exchanges. There were in Paris on October 31, 1902, 29,478 main stations at 400 francs each, 261 state service stations paying 200 francs, 525 departmental service paying 300 francs, 52 season subscribers paying 200 francs, 51 interurban or toll line stations at 150 francs, and 9,988 extension lines to main lines paying 50 francs. This makes a total of 40,555 stations, or only 1.49 stations for every 100 inhabitants, this being much lower than usually obtains in other cities in Europe and far below what prevails in the United States. The apparatus, with the exception of the batteries, is furnished by the subscribers, but the maintenance is at the cost of the state. The patronage of the system, moreover, is not very extensive, as it appears that the daily use of the instrument does not reach above five conversations on the part of 53 per cent of the subscribers, while less than 9 per cent use the telephone more than 15 times a day.

Under these circumstances Mr. Sembat advocates the message rate system, which he states is already in use exclusively or combined with a flat rate in the United States, Australia, Japan, Germany, Denmark, Switzerland and Great Britain, and he points out also the remarkable increase in the yearly number of subscribers which has occurred as the result, instancing New York City, where

the yearly increase of 530 under the flat rate rose to 6,862 under the measured rate.

Mr. Sembat insists that a reform of this kind ought to be made, although he admits that considerable change in mechanism and apparatus would be necessary, but he points out how inferior is the service given to the public at the present time, and some of his descriptions would be amusing if they were not pathetic, viewed from the standpoint of the subscriber. He describes the public standing in front of the telephones with eternal patient waitings, then wild calls and frequent sarcastic remarks not altogether destitute of blasphemy, stampings of the feet and a general attitude of excited indignation, which at last ends with a slamming down of the instrument and often a precipitated rush in a fiacre to the residence of the friend with whom it was desired to hold intercourse. On the other hand, the description of the employees by Mr. Sembat is equally discouraging, and a sort of half apology is made for the saucy or piteous replies of the telephone girl, who has lost her head, driven beyond her strength by overwork, and is pretty nearly out of her mind. Speaking as a socialist, Mr. Sembat says that no private company without laying itself open to all kinds of fines and penalties would have dared to do that which the state has done in respect to this matter, and he closes by remarking that, important as it is, to afford the majority of the people the use of the telephone, financial conditions are such that the new message rate or the new flat rate must be sufficiently large to prevent any further deficit in the budget.

Electricity for Swiss Railways.

Mr. O. J. Hughes, U. S. Consul General at Coburg, Saxony, reports to the State Department as follows: Owing to the increase in the price of coal during the last few years, Mr. Thormann, a prominent Swiss engineer, wished to find out whether it would not be an advantage to use electrical energy, furnished by hydraulic plants, over the whole of the railroad system of Switzerland. After investigating the subject he published a report which has awakened considerable interest and will no doubt bring about some practical results in this direction. He finds that the substitution of electricity for steam on the railroads is quite practicable and has many advantages, although it will not bring about any considerable reduction in the cost of operating the roads.

The five main railroads in Switzerland require over 30,000 hp daily. In order to organize a complete electrical service it will be necessary to obtain about 60,000 hp in the shape of alternating current of high tension, not counting the reserve supply, which is indispensable. Not taking into account the considerable number of falls which are not utilized in the country there exist already 21 large hydraulic plants which can give a total of 86,000 hp. These include the plant of Siel, near Linsiedl, which has a capacity of 20,000 hp; the Laufenburg plant, on the Rhine, giving also 20,000 hp; and five others, giving each 5,000 hp. He enumerates 21 plants which will be more than sufficient to supply the electrical energy needed for the Swiss railroads.

The cost of changing over the system would, of course, be considerable. It is to be noted, however, that the adoption of the electrical system would have the great advantage of doing away with the present consumption of coal, which is now imported, and that the use of hydraulic energy would be of great benefit in developing several branches of manufacturing.

The publication of Mr. Thormann's report aroused considerable attention in different quarters, and already one of the railroad companies has applied to the government for an authorization to use electric trains on a trial stretch of road 12 miles long.

Kentucky Independent Telephone Association.

The Kentucky Independent Telephone Association held its annual meeting in Paris, Ky., on October 13 and 14, last. Representatives from the leading telephone companies in the State were present. Papers were read on the following-named subjects: "The Manager and His Corps," by David Prewitt, of Winchester; "Toll Collections and Traffic Arrangements," by James S. Bailey, of Wauseon, O.; and "The Outlook," by John R. Allen, of Lexington, Ky.

The following-named gentlemen were elected officers for the ensuing year: President, D. L. Pendleton, of Winchester; vice-president, John T. Hinton, of Paris; secretary, James Maret, of Mt. Vernon, Ind. Executive Committee: David Prewitt, of Winchester; George S. Shanklin, of Lexington, and J. J. Mitchell, of Lexington. The time and place of the next annual meeting were left open for later decision.

CURRENT NEWS AND NOTES.

CABLES LAID ON GROUND.—With the idea of overcoming the suspension of communication with the north from Vancouver, B. C., by the government telegraph being broken by heavy snow falls, the Dominion Government will lay a cable over three ranges of mountains, strong enough to withstand whatever may fall upon it. E. A. Hawley, one of the foremen in charge of the construction in the north, who is now in Vancouver, said that sleet is the worst enemy of the telegraph lines in the North. The lines are being constantly broken and it is often very difficult to find the ends in the snow. Last winter the experiment was tried of laying a cable over the mountains, allowing it to be covered by the snow, and although it was not a complete success, it demonstrated the fact that with a proper wire there would be little trouble. A heavier and properly-insulated cable is now being prepared, of sufficient length to extend over three ranges of mountains, where the present trouble is experienced.

AMERICAN ELECTRO-MEDICAL SOCIETY.—The first annual meeting of this society will be held December 1, 2, 3, at the Masonic Temple, Chicago. This society, which already numbers over one hundred and fifty members, has for its object "investigation in electricity and allied sciences and the encouragement of their application to medicine and surgery by the formation of district and local societies." Papers will be read by Dr. John B. Murphy, Chicago; Dr. Byron Robinson, Chicago; Dr. G. Betton Massey, Philadelphia; Dr. J. Mount Bleyer, New York; Dr. C. S. Neiswanger, Chicago; Hon. John M. Smulski, city attorney for Chicago; Dr. J. Rudis-Jincinsky, Cedar Rapids, Iowa; Dr. H. Preston Pratt, Chicago; Hon. Edward B. Elliott, city electrician for Chicago; Dr. Clarence Skinner, New Haven, Conn.; Dr. J. N. Scott, Kansas City, Mo.; Dr. R. S. Gregg, Chicago; Dr. Mirhan K. Kassabian, Philadelphia; Dr T. Proctor Hall, Chicago; Dr. A. D. Rockwell, New York; Dr. Carl S. Beck, New York; Dr. Heber Robarts, St. Louis, Mo.; Dr. John E. Gilman, Chicago; Dr. Charles G. Davis, Chicago; Dr. C. P. Clemensen, Chicago; Dr. J. P. Hetherington, Logansport, Ind.; Dr. O. O. McMicheal, Chicago; Dr. O. S. Barnum, Los Angeles, Cal.; Dr. Elmore Pettyjohn, Chicago; Dr. George F. Hawley, Chicago; Dr. John E. Harper, Chicago; Dr. Lloyd Hammond, Chicago; Dr. Hamilton Forline, Chicago; Dr. R. H. Bartlett, Chicago; Dr. H. P. Fitzpatrick, Chicago. The secretary is Mr. T. P. Hall.

FARMERS AND THE TELEPHONE.—An item from Fargo, N. D., says: "The encroachment of modern facilities on older methods of doing business is strikingly exemplified in this part of the Northwest this fall. These days of private telephones and telegraph lines to every station and almost every big farm throughout the State have brought the farmers into touch with the terminal grain markets of Duluth and Minneapolis in such a way as to euchre the country elevator lines out of all chance of profits by advance information. Often the changes in quotations at either Duluth or Minneapolis are in the hands of farmers at their homes within ten or twenty minutes after they have been made, and in some cases elevator companies having country line houses have found it very difficult to keep even with the farmer. This is especially the case with a long-continued advance or decline. A farmer will store his grain in the country house nearest his farm, and as long as prices advance or remain stationary he will let it stay there, taking a storage ticket, which he leaves with a friend in town or at the bank. Being in such close touch with the terminal markets by telephone, he knows at once of any change in price, and if it is a decline he at once telephones to the bank or his agent to sell at the old price, and this is done so quickly that the sale is often made before the country elevator has received word by wire from Duluth to make a change in quotations. In that case the elevator line is out the difference in price, as it has to sell its grain on the terminal market at once."

WIRELESS TELEGRAPHY IN ITALY.—It is announced that the Italian Government will soon begin on the royal estate of San Rossore the construction of an extraordinarily powerful wireless telegraph station for the establishment of communication between Italy and the Argentine Republic.

A. I. E. E. MEETING.—The 181st meeting of the American Institute of Electrical Engineers will be held at the Chapter room, Carnegie Hall, 154 West Fifty-seventh Street, New York, on Friday, November 20, at 8:15 P. M. The following papers will be read and discussed: "The Electric Conductivity of Commercial Copper," by Lawrence Addicks; "The Comparative Behavior of Floating and Booster-Controlled Batteries on Fluctuating Load," by Lamar Lyndon.

REPORT OF A SPEECH BY "ELECTROPHONE."—Mr. Joseph Chamberlain made a speech at Birmingham, England, on the night of November 5, and, according to a London dispatch, reporters of the *Daily Mail* took the speech down in shorthand at London, a distance of 113 miles. What the British newspaper designates as an "electrophone" was used for this purpose, and it is stated that every word was distinctly heard by the reporters. The speech was printed verbatim and the paper was selling on the streets 27 minutes after the speech was concluded.

NICKEL MINES OF ONTARIO.—Professor Coleman, of the University of Toronto, who has recently investigated the Sudbury nickel ore deposits for the Ontario government, reports that he found the Sudbury deposit practically a continuation of the southern range, the whole forming a great oval 40 miles long and 20 miles broad. In quantity the Sudbury deposits surpass any other nickel deposits in the world; in percentage of nickel in the ore, however, they are hardly up to the deposits of New Caledonia. The average percentage of nickel is about 2.5 per cent., though some ore runs as high as 5 per cent. There is more sulphur and copper in the ore than in New Caledonia ores.

THE FRENCH INSTITUTE, according to a recent cablegram, has appropriated the sum of 7,000 francs for the purpose of "an investigation to settle a difference of opinion between French and American authorities concerning a point in electrodynamics." This doubtless refers to the Rowland experiment on the electromagnetic effect of a rotating electrostatic charge. Mr. Harold Pender has received a grant from the Carnegie Institution for an experimental investigation of the subject, to be made in Paris in collaboration with M. Victor Cremieu. The latter savant has attacked the correctness of Rowland's deductions from his experiment, and it is possible that the French grant was made in his interest.

BARBED WIRE TELEPHONY.—Two years ago a number of farmers in Eastern Washington became convinced that they could enjoy the benefits of a telephone system by connecting their barbed-wire fences and attaching telephone instruments. Within a year hundreds of miles of barbed-wire telephone lines were in use in the Palouse, Big Bend and Walla Walla wheat districts. Having become accustomed to the advantages of the telephone, the farmers are now dissatisfied with the slow method of the barbed-wire lines. In consequence, several good-sized corporations have been formed in various districts to supplant the barbed wire with pole lines and to give the rural communities better service. The farmers' pioneer lines have paid handsomely where charges were made, making large profits likely when better facilities are afforded.

PRICES OF CURRENT.—Mr. F. H. Mason, United States Consul-General at Berlin, states that on the first of January, 1904, the cost of electric current for lighting purposes in Berlin will be reduced from 55 pfennigs (13¾ cents) to 40 pfennigs (10 cents) per kilowatt-hour. This change of price is made to meet the competition of gas, which is furnished for lighting as well as for heating and cooking purposes at 3¼ cents per cubic meter (35.316 cu. ft.). The rates for lighting purposes per kilowatt-hour in some other European cities are as follows: Breslau, 17 cents; Budapest, 23½ cents; Christiania, 14 cents; Genoa, 18 cents; Cologne, Leipzig and Nüremburg, 18½ cents; Dresden, Frankfort, Munich and Hamburg, 15 cents; Copenhagen, 14 cents; Rotterdam, 17 cents, and Vienna, 15 cents. For power purposes electric current is supplied in Berlin as low as 17 pfennigs (4¼ cents) per kilowatt-hour, and when used in large quantities during daylight hours this price is still further reduced to 14 pfennigs (3½ cents).

TO RESIST THE CHICAGO UNION LOOP.—Organized opposition to the "encroachments" of the Union loop, together with demands for a better service, are the features of a movement initiated by property owners in the four streets occupied by the loop. A permanent organization, employing an attorney, has been formed to accomplish the reforms which business men have been urging for a year or more. The objects of the organization are: The prevention of any further encroachment over the streets, such as the extension of platforms, the removal of all signs on platforms and in cars, the removal of disused stairways along the loop, and the lessening of the noise on the latter. The corporation counsel has already ordered work which was under way on the extension of the platforms, suspended, and the Union Loop Company, through its attorney, has applied for an injunction to restrain the city from interfering with the plans. A stay of proceedings has been granted until the property owners can be consulted.

RADIOACTIVE WELLS.—Prof. H. A. Bumstead, of Yale, in a recent interview, says: "At the request of Prof. J. J. Thomson, who was visiting here last spring, Prof. Wheeler and myself undertook to find out if a radioactive gas existed in the deep-level waters of this vicinity. He called our attention to the work done in the Cavendish Laboratory on a radioactive gas found in waters coming from deep levels in that region. We secured some water for experiment from a spring near New Milford, Conn., which was estimated to be about 1,500 ft. deep, and found that it was radioactive. We then took some water from one of the surface lakes here, which is used as a reservoir, and we found this, to our surprise, to contain a strongly active gas. We tried the water direct from the lake, and after it had come through the pipes, but the result was the same. The water was then taken and after the gas had been expelled was aerated by dropping and allowed to stand for sixteen days, but it did not recover the power of giving off an radioactive gas. That was the experiment that indicated that the gas does not come from a radioactive substance dissolved in the water."

"A ROUSING TIME."—An item from Boston, Mass., says: "W. E. Shaw, of Brookline, gave an 'electrical party' last night, the feature of which was the exhibition of an electric clock for blind deaf mutes. Mr. Shaw is deaf and dumb, and he was assisted in demonstrating the workings of his invention by Tommy Stringer, blind, deaf and dumb, who is making great progress in the sciences. The clock not only tells the time, but alarms the sleeper by agitating a lever which is connected by a string to a pillow, causing the pillow to move up and down, the vibrations being communicated to the sleeper by a touch. A circuit is closed, by which an electric current is sent through a small incandescent lamp in front of a parabolic mirror, the rays of which are thrown into the face of the sleeper. It releases a spring connected with a hammer, which falls upon a fulminating cap, the loud explosion of which at close quarters is perceptible to a deaf person. It also gives notice of the entrance of burglars by any of the above methods, by means of connection by a wire with the doors and windows. It gives indication of fire by electric thermostats placed anywhere on the premises."

AN EMPLOYERS' UNION.—At Chicago, on October 30, with the election of D. M. Parry, of Illinois, as president, the formation of the Citizens' Industrial Association of America was completed. The organization is fully national in scope, and includes manufacturers, tradesmen and other employers of labor. Other officers were elected as follows: First vice-president, J. C. Craig, of Denver; second vice-president, E. W. McLeary, of the National Electrical Contractors' Association, Detroit; third vice-president, J. T. Hoile, of the Manufacturers' Association, New York; treasurer, A. C. Rosencrantz, Evansville, Ind. Resolutions were adopted by the organization. They refer to strained relations between employer and employees and their bad effect on business conditions; demand ample protection for all seeking to earn a livelihood, and continue in part: "In carrying on a firm and uncompromising contest with the abuses of unions as now constituted and conducted, at the same time acknowledging the free right of workmen to combine, and willing that the combination when rightly constituted and conducted may prove highly useful, we earnestly desire to act, and believe we

are acting, in the true interests of the workingmen themselves." A convention of the Association will be held in Indianapolis next February.

THE METRIC SYSTEM IN GREAT BRITAIN.—Some weeks ago we referred to the endorsement of the metric system by the British Congress of Chambers of Commerce of the Empire at its Montreal meeting in August, and we give below the text of the resolution. Lord Strathcona was the honorary president of the Congress and Lord Brassy the president. The honorary vice-presidents include the principal higher officials of the Empire. At the Montreal meeting there were present delegates from 75 British chambers of commerce, and from the chambers of the principal commercial cities of India, Ceylon, Egypt, South and Central Africa, Canada, the West Indies, Australasia, Hong Kong and Malta. An amendment to the resolution recommending that the appointment of a royal commission be asked to consider the question of the adoption of the metric system was voted down by a large majority, one of the speakers saying that the original resolution should not thus be weakened, but that the matter should be so forced upon the government that it will be bound to take action. The resolution was adopted as follows, with few dissenting voices: "That this Congress, having had under its consideration the following resolution, adopted at the conference held in London during the months of June, July and August, 1902, between His Majesty's Principal Secretary of State for the Colonies and the Prime Ministers of the self-governing colonies of the British Empire, namely: 'That it is advisable to adopt the metric system of weights and measures for use within the Empire, and the Prime Ministers urge the governments represented at this conference to give consideration to the question of its early adoption,' hereby expresses its hearty concurrence therewith, and urges upon the Government of the United Kingdom the necessity for legislative measures being taken in the interests of British trade and commerce to make the use of metric weights and measures compulsory."

LETTER TO THE EDITORS.

Impulse vs. Impact in Steam Turbines.

To the Editors of Electrical World and Engineer:

SIRS:—There is a confusion of phraseology in most of the papers on the subject of the steam turbine, which I consider important enough to call attention to.

Mr. W. L. R. Emmet in his paper before the American Philosophical Society, published in your columns April 11, 1903, as well as the writer of the editorial in the issue of May 23, and in the article in the same issue constantly speaks of the "impact" of the steam against the vanes. For instance, we read on page 609, issue of April 11:

"In steam turbines the expansive force imparts motion to the steam itself, and this motion is given up to a revolving part by impacts of the moving steam upon it."

Again on the same page, speaking of Parsons turbine, Mr. Emmet says:

" . . . . giving up its velocity by impact with the moving vanes!" and again on page 610 the same author is found to say:

"This process of expansion in nozzle and subsequent abstraction of velocity by successive impacts with wheel vanes is generally repeated. . . . . "

The writer of the editorial on page 857 says:

"The energy of this moving stream is then transformed into mechanical motion through impact on the vanes. . . . . "

And the writer of the article on the "Curtis Steam Turbine" says, on page 859:

"A jet striking a surface will exert definite pressure against that surface, the value of which, in the case of normal impact, is expressed by half the square of the velocity per second into the mass of fluid delivered against the surface per second. Should a surface against which such a jet impinges, such as that of a vane attached regularly to a shaft, remain fixed, there will, of course, be no energy delivered to the shaft; it is also evident that should the vane have the same velocity as the impinging jet, no energy will be delivered, since there is no exchange of velocity between the jet and the vane. The maximum amount of energy delivered will be, when the vane has one-half (or, more accurately, a little more than one-half) the velocity of the jet; for, in that case, the remaining velocity in the jet after impact will equal the velocity of the vane, and, therefore, be incapable of imparting further energy. Consequently, leaving aside any secondary actions, in order for a single-wheel steam turbine to act at a maximum efficiency, its vanes should have a velocity of about 2,000 ft. per second . . . . . "

The writers of these articles from which I have cited at length, seem to believe that the energy of a jet is imparted to the vanes of a turbine through the "impact" of the jet against the vanes. If such is their belief, it seems necessary to call their attention to the fact that what the turbine designer is most anxious to avoid is this very "impact," which means a loss of energy. Substitute for the word "impact" the word "shock," and it is unnecessary to further comment on the necessity of avoiding "impact," i. e., "shock" in turbines, whether for steam or for water.

The writer of the article on the "Curtis Steam Turbine" gives a proof for the fact that the most favorable velocity of a single-wheel turbine should be one-half the velocity of the jet. In the first place, it need hardly be remarked that this is true only for turbines operating as "action" turbines, i. e., turbines in which the entrance velocity of the jet into the running vanes is equal to the spouting velocity, or the velocity of free efflux. Such turbines are the Girard turbine and the Pelton turbine. The De Laval steam turbine also belongs to the same type. In single-wheel turbines in which the full spouting velocity of the jet is not used, i. e., in "reaction" turbines, the peripheral velocity of the wheel is always considerably greater than one-half the velocity of the jet.

As to the proof that the peripheral velocity of a single-"action" turbine wheel should be approximately one-half the velocity of the jet, the reasoning of the author of the article on the Curtis steam turbine is erroneous. The true reason is that, in order to abstract the energy of the jet "without impact or shock," it is necessary that the velocity of the moving vane be such that the fluid can glide into the bucket along the vane without losing energy by impact or shock. The jet once having entered the bucket or vane, it is essential to bring the velocity of the fluid down to as small a value as possible, and this is done by the peculiar curvature of the vane. Assuming the angle of entrance of the vane equal to the angle of the vane where the jet leaves it, it follows at once that, neglecting friction, and assuming the fluid to leave the wheel normally to its surface, the velocity of the vane at which impact is avoided must be equal to one-half the velocity of the jet multiplied by the cosine of the angle at which the jet is inclined to the surface of the wheel.

Following the reasoning of the author on the Curtis steam turbine, it can easily be proved that the efficiency of a turbine in which the fluid acts by impact never exceeds 50 per cent., for by his assumption the vane is supposed to move at one-half the velocity of the jet, and it follows that one-fourth of the original energy remains in the jet, whereas another one-fourth of its original energy is destroyed by the impact of the jet against the vane. Thus, only 50 per cent. of the energy of the jet can be utilized, which 50 per cent. would yet be considerably diminished by frictional resistances.

The writers of the articles from which we have quoted have obviously confounded "impact" with "impulse." In dynamics we understand by "impulse" a difference in momentum, by momentum being understood the product of mass into velocity. In "action" turbines this momentum is utilized, and for that reason such turbines have been termed "impulse turbines." Such loose phraseology is apt to produce incalculable harm, by introducing a confusion of ideas, which is to be especially guarded against with a subject such as that of the steam turbine, about which the general engineering public for some reason or other seems to be profoundly ignorant.

SOUTH NORWOOD, OHIO. B. A. BEHREND.

[Whether "impact or impulse" is the proper word to use in descriptions of turbine action appears to be rather a matter of convention than one of correct phraseology. The first mentioned word refers more especially to an act of contact or "impression by touch," while "impulse" relates to the dynamic results of such contact—the former being necessary to the latter. That is, one is the condition and the other the result. It is true that ideas connected with impact of solid bodies may be transferred to fluid action, thereby confusing

thought; but the other significations of the word "impulse" may, in its use as suggested, also give rise to similar confusion of thought. As to the analogy of the pile driver, there can be no such thing as "shock" in fluid action, and the analogy to that extent is not apposite. Under certain conditions internal eddies may result, involving lines of energy, but these are rare.

In the illustration of the action of the impinging jet to which Mr. Behrend refers, it was assumed that the jet would flow off the vane in reverse direction to the direction of motion of the vane. For maximum efficiency in the ideal case, this implies that the jet should have a reverse velocity equal to the forward velocity of the vane, or a zero velocity with respect to the earth, or, in other words, that the vane should have one-half the velocity of the impinging jet. Mr. Behrend in this case apparently has confused relative and absolute velocities, and his ratio ad absurdam that the efficiency of a turbine in which the fluid acts by impact never exceeds 50 per cent., thus rests on false premises. The condition considered is, of course, and as indicated in the article, an ideal one, not attainable in practice. In the general case the most efficient ratio of jet and vane velocity will depend upon the angle of vane and angle of approach, and does not permit of any simple expression.

The definition which Mr. Behrend in the final paragraph of his letter gives of impulse, is not that which is usually accepted. In fact, the definition of impulse as a differential of force makes it simply force. The fact is that the words "impulse" and "impact" have always been used with some breadth of meaning, but usually the context is so clear that no such confusion should result as Mr. Behrend fears.—EDS.]

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Motors Without Phase Difference.—LATOUR.—An article illustrated by diagrams in which the author first recapitulates the results of a former article which was referred to in the Digest July 4, and in which he gave the theory of a repulsion motor, the stator of which is wound like a modern armature having only a single winding like that in a direct-current dynamo. The operation of such a repulsion motor near synchronism is perfect in respect to commutation. In practice, if running with carbon brushes, it may be used between rather wide limits of speed. The starting torque is as great as for a polyphase induction motor, with resistances inserted in the rotor winding. A special feature of the repulsion motor is that at no speed is there any energy consumed in resistances. Such a motor with fixed brushes shows the general properties of a series motor, namely maximum torque when running up from rest, and zero torque at a theoretically infinite speed. If the question of commutation, when starting under heavy load, may be assumed as solved, such a motor is very suitable for hoisting and traction purposes, although it has the serious disadvantage that its power factor is rather low. The author now shows that it is possible to build, without special complications, single-phase motors with commutators which have a power factor equal to unity. If n-phase currents are supplied to a two-pole, ring-armature with commutator by means of n brushes symmetrically distributed around the commutator, the reactance of the ring diminishes with the speed and becomes zero at synchronism, while beyond synchronism the ring acts as condenser. But if single-phase currents are introduced through two opposite brushes, the inductance is constant at any speed. It is, however, as easy to obtain the same results in the latter case as in the former. If, besides the brushes, $a\,b$, through which the single-phase current is supplied to the armature, another set of auxiliary

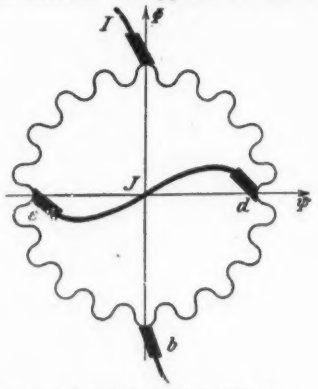


FIG. 1.—LATOUR SINGLE-PHASE MOTOR.

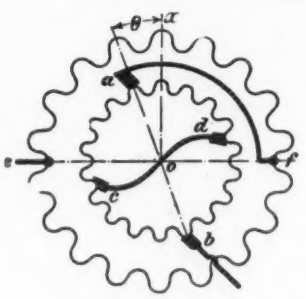


FIG. 2.—SERIES SINGLE-PHASE MOTOR.

brushes, $c\,d$, is used, as shown in Fig. 1, the two currents between the two sets of brushes produce two fluxes; and it is shown that the reactance of the ring armature diminishes with increasing speed, and becomes zero at synchronism, while beyond synchronism the ring acts as a capacity. We have here the same phenomena as in a polyphase motor. The commutation at the brushes a and b is perfect at any speed, while at the brushes c and d the commutation is perfect at synchronism only. Below synchronism there is a counter e.m.f. in the segments short-circuited by the brushes $c\,d$, which is too strong for thhe commutation of the current, J, and above synchronism the counter e.m.f. is too small. The conditions of commutation are most difficult at starting. Under the supposition that the commutator has m segments, and that v volts are applied between a and b, the counter e.m.f. in question becomes $\pi v \div m$. This e.m.f. may become 2.5 or 3 volts without danger if carbon brushes are used. If the rotor of Fig. 1 is placed in an ordinary single-phase stator, it is at once seen that a single-phase motor with a power factor equal to unity can be attained. If, for instance, the stator is connected in parallel with the rotor with the aid of a transformer for diminishing the voltage, a shunt motor is obtained analogous to the direct-current shunt motor. For a certain position of the brushes the motor, when not loaded, attains a certain characteristic speed equal to synchronism, or below synchronism or above synchronism; and when the motor is loaded without changing the position of the brushes, the speed drops by a few per cent. It is preferable to arrange it so that the speed of the loaded motor corresponds to synchronism. Such a motor being neither a synchronous nor a non-synchronous motor, is called a "panchronous" motor. A shunt motor which is adjusted to operate at no load without phase difference, continues to operate without phase difference when loaded. This single-phase shunt motor may be used for shops or in power transmission work. It is started by disconnecting the rotor and stator and operating the motor as a repulsion motor. Since the method of starting is easy, the author thinks that this shunt motor may even find application for traction, if it is not required to use a variable speed. The series connection (as shown in Fig. 2) is, however, more interesting for traction purposes. The author gives the mathematical theory and shows that the torque at any speed is essentially a function of the position of the brushes, and may be adjusted accordingly. When tested, such motors are said to have given very good results.—*Elek. Zeit.*, October 22.

Compensated and Compounded Alternators.—HEYLAND.—A brief reply to the article of Meyer abstracted in the Digest November 7. The writer says that his former communication was apparently misunderstood by Meyer, since his own remarks related to generators already made and fully tested, and the suppositions advanced by Meyer are for the most part fallacious.—Lond. *Elec.*, October 23.

FLYNN.—Another communication on Meyer's article. He thinks that only a very small saving can be achieved in the width of an alternator by increasing the armature ampere-turns in the case of a machine excited in the ordinary way, since it will be necessary to work with less density at no load in order to keep the increase in the exciting ampere-turns, required to uphold the voltage at full load, within reasonable limits. Nothing but a very material reduction of the self-induction of the armature winding can lead to a real saving in such a case. He refers to a method which he has applied for getting constancy of voltage. He used an arrangement similar to a hot-wire voltmeter, of the Hartmann & Braun type (made by the Stanley

Company in this country), carrying a horizontal lever instead of the usual pointer, and traveling through a comparatively wide angle for a very small alteration in voltage. This lever closed the circuit of one or the other of two magnetic clutches, determining the travel of a spindle which cut resistance in or out of the exciting circuit, as required, in order to keep the voltage constant. The main voltage transformed down to a suitable value was applied to the relay terminals. Had compounding been required, an electromagnetic relay would have been used. The arrangement worked very well and kept the voltage of the alternator constant within the limits of the machine, for all loads and power factors.—Lond. *Elec.*, October 23.

An editorial note stating that as the difference of opinion between Heyland and Meyer appeared to be largely on the question of the actual cost of the machines in question, the editor had written to the two companies which Heyland and Meyer represent and asked them to quote for two machines of standard size. Heyland's company sent a quotation, while Meyer refused to do so because he feels that the comparison of two quotations of different firms on the basis of a plant which will never be in existence, is of very little practical use. He thinks that to arrive at conclusions of any value, the quotations of both types of machines should be made at least on the same basis of profit, guarantee and workmanship. He says that the question of cost is not the only issue, but that a break-down in the exciting arrangement of the generator would be a serious matter with the Heyland type. With the standard type, provisions are always made for a separate source of excitation, but with the Heyland type a complete generator has to be kept as spare, and since the starting of the engine and the paralleling will take some time, it may mean a serious overload on the station.—Lond. *Elec.*, October 23.

Output Coefficient.—ESSON.—An article on a basis for the comparison of dynamo designs. He criticizes some points in an article of Hobart, abstracted in the Digest of October 10. The gist of the contention is as follows: There is an active surface of certain dimensions moving in a magnetic field with a certain velocity, and the quality of the design is indicated by the magnitude of a coefficient which expresses the "generative value" of each square inch of surface moving at that particular velocity. This value depends on the magnetic induction in the gap, on the spread of the poles, on the relation between the iron and the copper on the active surface, on the current density in the conductors, etc. The writer states that as a matter of every day estimating there has been used in the offices of a British manufacturing company for some time a set of curves connecting the cost of the machine with its D^2L dimensions, and in Fig. 3 is shown the form these curves take. The reason for taking

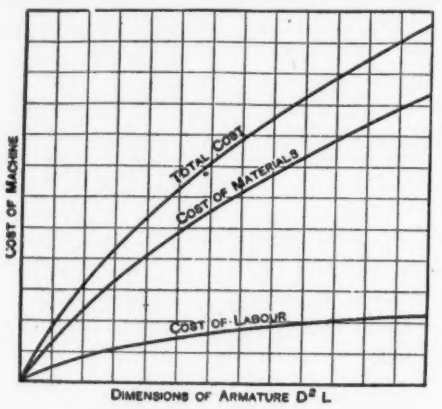


FIG. 3.—CURVES FOR OUTPUT COEFFICIENT.

D^2L instead of $D\,L$ is that in connecting the dimensions with the output, the latter involves taking into account the surface velocity, while in estimating, revolutions per minute are always dealt with and the curves are, therefore, in a handier form for estimating purposes than would be the $D\,L$ curves. Hobart prefers the latter, however, because he has found that it approximates in practice, taking the overall dimensions of the armature, a straight line. This may prove a very useful coincidence. The author objects, however, to Hobart's designation of the expression $W/\pi\,D\,L \times r.p.m.$, as "specific output" for two reasons. First, the dimensions of the space on the armature taken up by end connections have no place in an expression that purports to show whether the active surface has been utilized to advantage, for the simple reason that the space so taken up is not active. Secondly, the expression, while containing in πD r.p.m. the surface velocity, does not contain the other essential factor, which is the extent of the surface, but only one of its dimensions. In an editorial note on the article, it is pointed out that Esson does not dispute the utility of Hobart's results, and that the point of the latter's article is that $\pi D\,L$, when L is taken as the length of the armature over the end connections, is a true criterion of cost, so that the ratio $W/\pi D\,L$ measures the efficiency of design in regard to cost, if the output is considered to be proportionate to speed. It seems, however, that Hobart did not contemplate applying his criterion over such large ranges of speed as Esson does, and the latter is perhaps right in maintaining that if widely different speeds are to be compared, a formula with D^2 in it gives a ratio more justly entitled than Hobart's to be called "specific output."—Lond. *Elec.*, October 23.

Iron Losses.—PRESS.—A communication referring to his article abstracted in the Digest November 7. He points out that in this article the factor "2½ times" refers to eddy losses entirely. In the machines in question the total experimental determined iron losses were found to follow a law such that, with a fair degree of accuracy, they could be split up into two components, one dependent directly on the frequency for a given density and the other dependent upon the square of the frequency. The first component was found to agree very well with what would be expected to occur by measuring the hysteresis losses by means of the ordinary laboratory ring experiments. The second component, however, depending upon the square of the frequency (presumably the eddies) was found to be 2½ times greater than would be expected assuming a sine wave of flux. When analyzing the flux distribution curves and taking note of the character of the flux wave, this factor "2½ times" is practically accounted for. —Lond. *Elec.*, October 23.

REFERENCES.

Surging of Alternators Connected in Parallel.—BENISCHKE.—A very long communication in which he continues his polemic with Goerges and Rosenberg concerning the mathematical theory of the phenomenon of surging of alternators when connected in parallel. He strongly maintains his position against that of his opponents.—*Elek. Zeit.*, October 22.

Dynamo Design.—An anonymous article on the influence of some constants on the dimensions of a dynamo. The article gives general rules for dynamo design, and as it is chiefly mathematical, containing many tables, it cannot be satisfactorily abstracted.—*Zeit. f. Elek. u. Masch.*, October 16.

LIGHTS AND LIGHTING.

Osmium Lamp.—Some notes taken from a report of the *Deutsche Gasgluehlicht A. G.*, which sells the osmium lamp in Germany. In a test made by the German Reichsanstalt of 38-volt osmium lamps during 600 hours, it was found that the consumption of current of the 30 and 35-cp lamps was 1.28 amp., so that the consumption of power is 1.43 to 1.58 watt per candle of average illumination perpendicular to the axis of the lamp. A considerable decrease of the candle-power during the 600 hours was not observed. Other tests were made by Wedding, who found that the osmium lamp when suspended vertically consumed 1.4 watt per candle against 2.5 to 3.5 watts with the carbon filament lamp. The absolute life of the lamp is far beyond 1,000 hours. Although one lamp was destroyed after 520 hours, the others which were tested had an absolute life of more than 3,320 hours. The higher the candle-power, the longer the absolute life. The "net" life of a lamp is the time in which the candle-power is reduced to 20 per cent. of its original value; none of the tested lamps decreased its candle-power to such a degree before the filament was destroyed. This means in practice a considerable advantage over carbon filament lamps. While the latter lose candle-power on account of the blackening of the globe, the osmium lamps remain clear and decrease in candle-power much more slowly. An auxiliary apparatus for introducing the osmium lamp has been placed on the market under the name of "divisor." This is a device for dividing the voltage into several equal parts, and is to be used where the lamps are not to be worked in series, but independently of each other. It is a transformer with a single winding (meaning evidently an inductance coil), divided, for instance, in three equal parts. When its terminals are connected to a voltage of the network equal to 120 volts, this voltage is divided into 3×40 volts. This enables one to supply three circuits of osmium lamps independently of one another. The advantages of this device over an ordinary transformer are higher efficiency and smaller cost. The company is making two types of these devices, one for 3×2 and one for 3×10 lamps.—*Elek. Zeit.*, October 22.

REFERENCE.

Lamp Fittings.— An illustrated description of several novelties in incandescent lamp fittings, placed upon the market by continental manufacturers.—*Zeit. f. Beleucht,* October 20.

POWER.

Gas Engines and Steam Turbines for Dynamo Driving.—An editorial note referring to a recent report of Robinson on the impending change in engineering practice indicated by the frequent adoption in new projects of gas engines or steam turbines instead of reciprocal steam engines for driving dynamos. It is said that British engineers were the pioneers in fast-speed engine practice, and in the application of steam turbines to dynamo driving. The first gas-driven electricity works of a large size was a British one. Yet for some reason the British engineers did not pursue their advantage and slow-speed engines became fashionable. "Continental engineers took up the problem of gas engine design where the British left it, and American engineers found it expedient to test the capabilities of the steam turbine principle for large units. In both cases their enterprise was attended with satisfactory results, and now British engineers are taking up again what they discarded several years ago." —Lond. *Elec.,* October 23.

Electric Power in Textile Mills.—A brief illustrated article on the use of electric power in a small British textile mill. A 75-hp, three-phase induction motor is located at one end of the twisting shed and drives the line shafting by six cotton ropes running on groove pulleys. Twenty twisting frames are at present driven by the motor, each having 180 spindles running at 2,500 r.p.m. The frames are driven by belts from the line shafting, and any of them can be disconnected when required by the use of loose pulleys. It is believed that the polyphase induction motor is superior to any other type of motor for this work.—Lond. *Elec. Eng.,* October 23.

REFERENCES.

Turbo-Electric Generating Plants.—WILKERSON.—A paper read before the Leeds local section of the British Institution of Electrical Engineers. The author believes it is now becoming generally recognized that where condensing water is available, the steam turbo-generator has established a record for reliability, efficiency and durability, which constitute it a formidable rival to reciprocating engines, be they slow, medium or high-speed. Descriptions are given of the following turbines: De Laval, Parsons, Westinghouse-Parsons, Willans & Robinson, Brush-Parsons, Curtis. The economy of space and building and the economy in steam consumption are pointed out, and other advantages of steam turbo-generators are referred to.—Lond. *Elec.,* October 23.

Electricity in Mining.—ALLEN.—A fully illustrated article on the electrical and mechanical equipment of the Kimberley mines, which are said to represent an example of an up-to-date plant and advanced practice.—*Eng. Mag.,* November.

Mechanical Applications of Electricity.—RICHARD.—The first part of a fully illustrated article in which the author describes various new electromagnetic couplings; also stops controlled electrically from a distance.—*L'Eclairage Elec.,* October 24.

TRACTION.

Denver Tramway System.—A description of the main power house, the transmission and distribution system and special features of construction of the Denver Tramway Power Company. The new main power house will supplant five separate stations located in different parts of the city, from which current was formerly supplied for the operation of the several lines comprising the Denver system. There are five generating units, the engines being of the cross-compound type. Three are rated at 1,300 hp with a maximum capacity of 2,000 hp, directly-connected to 800-kw, direct-current railway generators, operating at 110 r.p.m., and delivering current at 575 volts. There is also one engine of 2,700-hp capacity, operating at 75 r.p.m., and directly connected to a 1,600-kw, direct-current railway generator delivering current at 575 volts. The fifth unit comprises a 2,400-hp engine operating at 94 r.p.m., and driving a 1,500-kw, three-phase, 2,300-volt, 25-cycle alternator, current from which is transmitted to the sub-stations. An elaborate system has been worked out for condensing the exhaust from the engines and for cooling the condensing water, which is described in detail. The direct-current switchboard, which was especially designed for this plant, consists of 42 feeder panels, 4 generator panels and 3 station panels. The negative and positive leads are separated as widely as possible, the generator panels being all negative and the feeder panels all positive, with a positive switch brought out to the equalizer stand at the generator bus. The alternating-current switchboard comprises two generator and three feeder panels. One high-tension feeder line has been built from the power house to a sub-station at the company's shops, and current will be transmitted directly at the generating voltage of 2,300. The equipment of this sub-station comprises seven 185-kw, oil-cooled transformers and two 500-kw rotary converters. Another high-tension feeder line will be carried to Arvada. Current will be transmitted on this line as far as Berkeley at 2,300 volts, and at this point a transformer station will be installed to raise the line voltage to 26,400 volts for transmission to the rotary converter sub-station at Arvada. Provision has been made in the distribution system for the establishment of other rotary stations, one of which will be located on the opposite side of the city, and to which current will probably be delivered at 2,300 volts. One of the heavy feeder lines is carried across the South Platte River and over the railroad tracks in the lower part of the city. The details are fully described.—*St. R'y Jour.,* October 10.

High-Tension Direct-Current Thury System for Traction.—BLACKSTONE.—An illustrated article on the trials made at present on a large scale on the line from St. Georges de Commiers to La Mure. The main traffic of this line is transportation of anthracite coal. Under the peculiar conditions of the road the number of trains and the number of cars drawn by a steam locomotive is limited. To increase the capacity of the line, electric locomotives have been resorted to, giving more power than the steam locomotive formerly used. Each locomotive is provided with four 600-volt, 125-hp, direct-current, series-wound motors connected in series. There are two trolley wires, the e.m.f. between the same being, therefore, 2,400 volts. The rails are used as the neutral in a three-wire system, for this purpose being in electrical connection with the joint between the second and third motors. The tension between each trolley wire and the rails is, therefore, 1,200 volts. The total weight of the locomotive is 50,500 kg. The electric operation of the line was inaugurated in August with good success.—*L'Eclairage Elec.,* October 24.

REFERENCES.

Austrian Mountain Road.—A description, taken from a report of Jordan, of the Mendel Railway, which is the first electric mountain road in Austria. On its steepest part it is operated as a cable road, beginning with a grade of 17.7 per cent. and terminating in a grade of 63 per cent. Three-phase currents are transmitted to a converter station near the road, where they are converted into direct currents. On the part which is operated by cable one car is always ascending the grade while another one is running down. On the other part of the road the trolley system is used.—*Elek. Zeit.,* October 22.

London District Railway.—A note on a recent report of Yerkes on the rapid progress which is being made in the "electrification" of the District Railway, and in the construction of the "tube lines" which are in the hands of his company. Extended precautionary measures are taken against the spread of fire, all the platforms being of cement, wood being completely discarded. Even the wooden staircases on the District Railways are to be replaced by iron ones.—Lond. *Elec.,* October 23.

Interurban Freight and Express.—A description of the organization, methods and facilities for handling express, baggage and freight of the principal interurban lines entering Cleveland.—*St. R'y Jour.,* October 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

British Gas-Driven Central Station.—An illustrated description of the recently-opened Ryde electricity works. The generating sets are operated entirely by producer gas. Since the district is essentially residential, the load curve can never be of the most profitable nature. It was, therefore, decided to put down plant of the least expensive type. Accumulators have been installed to deal with light loads when the station is shut down entirely. There are two sets of three-cylinder vertical gas engines of 200 maximum brake horse-power each, for a continuous working load of 150 hp at 210 r.p.m., each coupled directly to a six-pole, 480 to 530-volt dynamo, giving 200 amp. The engines work on the "Otto cycle" and are fitted with three cylinders, the cranks being set so that the shaft receives an impulse at every two-thirds of a revolution. Governing is effected by "throttling" the explosive mixture. The frequency of the impulses is the

same for all loads; the predetermined ratio of gas and air remains constant, but the quantity of mixture admitted to the cylinders is controlled by the governor, and thus the consequent strength of the impulse is in proportion to the load carried by the engine. The use of three cylinders and consequent frequency of explosions, coupled with the method of governing by "throttling," results in a very even turning movement of the crankshaft, and renders the engines particularly suitable for coupling directly to dynamos. By the adoption of the vertical type of construction, vibration is reduced to a minimum, and thus very heavy foundations are unnecessary. Some information is given on various mechanical details of the engines. Besides the two dynamos, a "balancing transformer" is provided, consisting of two separate machines. It is capable of dealing with an out-of-balance current of 100 amp., when not driving the two boosters, or of dealing with 15 amp. when driving them at full power. The balancing set is coupled directly to two booster dynamos for charging the storage battery, each being capable of giving a current of 100 amp. at 85 volts. These four machines are fitted on one girder bedplate, all armatures being coupled together. The battery of 260 cells has a capacity of 750 amp.-hours at the 75-amp. rate. About three miles from Ryde is the village of Sea View, and Spring Vale lies between them. Both these places and the road which joins them with Ryde, are lighted by the Ryde station, which, for this purpose, contains two motor-alternators of 5 kw and 20 kw, respectively, supplying single-phase currents at 2,500 volts, with a frequency of 50 periods per second to a concentric high-tension main having a section of 0.025 sq. in. By the side of this main a low-tension main is laid, having four cores of 0.05, 0.03, 0.05 and 0.012 sq. in. in section, respectively. Both these mains are looped into three transformers, two situated along the line and the third at Sea View. The first three cores of the latter cable form the low-tension alternating-current distributor for private lighting between Ryde and Sea View, while the 0.012-sq.-in. core, with the neutral (0.03) is used solely for lighting incandescent lamps along the road. The transformers are situated in the top chamber of the feeder pillars, shown in Fig. 4.

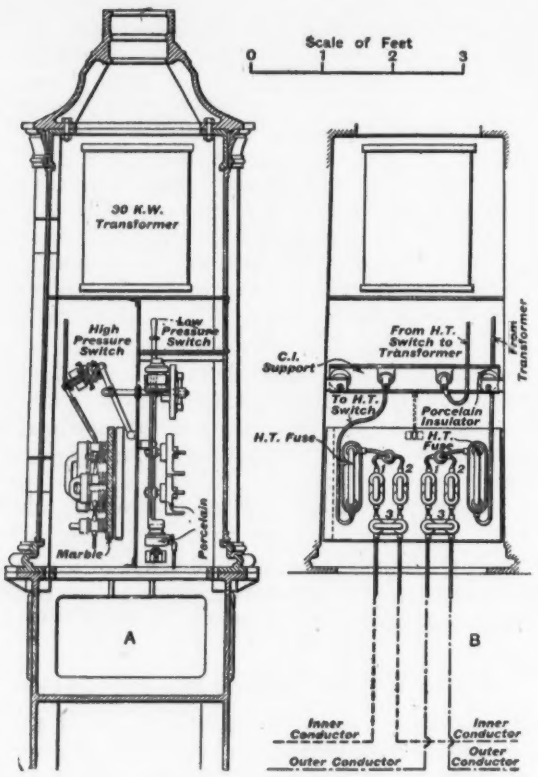


FIG. 4.—FEEDER PILLAR.

Each pillar is divided into three main compartments. The upper main compartment contains a 30-kw transformer. In the lower main compartment are placed the low-tension switch, links, etc. The middle compartment contains the high-tension switch and fuses and is again subdivided by a steel shelf through which projects the handle of the switches, as seen on the right hand of *A*. Since it is proposed to disconnect two transformers out of the three during hours of light load, and to switch them in again at night, a key to the smaller upper compartment only is given to an unskilled laborer. He will switch on or off both secondary and primary without being able to get at any live part whatever. The public lighting will also be controlled by a switch in this small compartment. The low and high-tension switches are mechanically coupled by levers joined by means of a pin working in slots. This arrangement insures the breaking of the secondary before the primary and the making of the primary before the secondary. In Fig. 4, *B*, it will be seen that the inner conductor of the concentric high-tension main may be cut off from the transformer by removal of links 1 and 2. The same applies to the outer, which is earthed at the station. This facilitates testing and in the event of a fault occurring on either conductor, the section may be isolated and the transformer fed back.—Lond. *Elec.*, October 23.

Increasing the Voltage in 110-Volt Central Station.—Wykander.—A communication referring to the proposal which has repeatedly been made and which has to some extent been introduced into practice (especially in England), to double the voltage in three-wire, direct-current systems, with 2 × 110 volts, in order to increase the capacity of the network. This change has serious disadvantages, especially the necessity of rewinding the dynamos and motors, doubling the number of cells in the storage battery, connecting arc lamps in groups of four instead of two in series, and replacing the incandescent lamps by others for a double voltage, which are less efficient, etc. He also thinks that the increase of the capacity of the network thus obtained is often very much more than can be utilized in practice. He thinks that in most cases it would be preferable to increase the voltage to a small degree only, say from 2 × 110 to 2 × 125, 2 × 130. The capacity of the network is thereby increased by about 19, 29 or 40 per cent. Such an increase could be generally made use of to good advantage and would not involve the disadvantages first referred to, the only necessary change being a slight increase in the number of cells of the storage battery used.—*Elek. Zeit.*, October 22.

REFERENCE.

Calculation of Transmission Lines.—Hruschka.—The conclusion of his article in which he discusses with the aid of diagrams the graphical method of calculating power transmission lines with converter stations.—*Zeit. f. Elek.* (Vienna), October 18.

Wires, Wiring and Conduits.

Cables.—J. Schmidt.—The first part of an article on the construction and manufacture of cables for other purposes than telephony and telegraphy (the Germans designate all branches of electrical engineering, except telegraphy and telephony, as Starkstromtechnik, and, therefore, speak of Starkstromkabel. We have no word for this except we adopt Swinburne's "heavy electrical engineering.") The author gives briefly an outline of the test made when a cable is delivered to the purchaser and of the guarantees which are generally given by the manufacturer. He states that cables for an e.m.f. of several thousand volts are nothing unusual now. Several firms make cables for 10,000 to 20,000 volts normal e.m.f., and no manufacturer would hesitate to make cables for higher voltages and to give corresponding guarantees. A German company is stated to have the facilities for making cables up to 40,000 volts. Another company exhibited at the Duesseldorf Exposition a three-core, 5,000-volt cable of 5 km. length, a three-core, 10,000-volt cable of 3 km. length, and a three-core, 50,000-volt cable of 750 metres length, the latter being used for lighting the main entrance. The same company exhibited a three-core cable, which was made for a normal voltage of 15,000, and was tested at the exposition up to 100,000 volts. As conducting material for underground cables, copper is used nearly exclusively, and only in very special cases has aluminum been used. The copper used has generally a resistance of one ohm for 60 metres length and one square millimetre cross-section. The smallest cross-section used in cables is one square millimetre. The largest is one thousand square millimetres. The author begins by giving a general outline of the various factors which determine the quality of a cable. The article is to be continued.—*Elek. Anz.*, October 18.

Electro-Physics and Magnetism.

REFERENCES.

Dispersion of Dielectric Constants.—Marx.—An account of experiments concerning the change in the capacity of a liquid condenser with the frequency of the discharging current. Drude has shown that for waves having a frequency of a thousand million per second, the dielectric constants of some liquids vary with the frequency. The present author has examined longer waves, say, about 10 to 34 metres in length. Within this region no dispersion was

found in the case of petroleum and benzol. In water also no dispersion of the dielectric constant could be traced.—From *Ann. d. Phys.*, No. 11; abstracted in Lond. *Elec.*, October 23.

Action of Iodine on Copper Films.—HOULLEVIGUE.—An account of a method of measuring the thickness of metallic films obtained by cathode projection. The thickness is measured by converting the film of, say, copper into iodide by suspending close to it a grain of iodine. Newton's rings are produced and by their color and configuration the thickness of the deposit may be deduced. When the thickness of the film is below 40 $\mu\mu$, it cannot be converted into iodide.—From *Jour. d. Phys.*, October; in Lond. *Elec.*, October 23.

Cathode Fall in Helium.—DEFREGGER.—An account of an investigation in which, in connection with the work of Mey, the author studied the "cathode fall" of a number of metals in helium, where a chemical action between the metal and the gas is excluded. The fall in helium generally is remarkably slight. The succession of the metals found by Mey is not maintained in helium.—From *Ann. d. Phys.*, No. 11; abstracted in Lond. *Elec.*, October 23.

ELECTRO-CHEMISTRY AND BATTERIES.

Standard Electrodes.—W. MCA. JOHNSON.—As a continuation of his articles on electrode voltage the author gives an illustrated description of the standard electrodes in practical use, especially of the hydrogen and calomel type. The advantages of the normal hydrogen electrode in fixing a line dividing the two classes of metals—base and noble—by their electrolytic pressure, and giving a measure of the chemical potential of the cathode and catholyte, and anode and anolyte, are so great that its use as a zero point in expressing electrochemical data saves much mental labor. As a working standard the hydrogen electrode presents, however, too great technical disadvantages. For most research work, the calomel electrode is admirable in its constancy and ease of manufacture. Its results can always be reduced to the normal hydrogen standard. For most practical work with a soluble metallic anode and metallic deposition, a standard electrode of the same metal and the same electrolyte as is used in the large vat is advantageous for two reasons; it is easy to make and set up, and it records differences between the original conditions of the electrochemical system and those set up by the changes in course of electrolysis.—*Electrochem. Ind.*, November.

REFERENCE.

Electrolytic Copper Refining.—SCHWAB AND BAUM.—A full account of the experiments which the authors have made to determine the best current density and temperature for copper refining. The paper contains all results in form of tables and diagrams. As the results of this investigation have already been given by Bancroft in a recent Electrochemical Society paper, references to the abstract of this paper in ELECTRICAL WORLD AND ENGINEER, September 26, page 519, must suffice.—*Jour. of Phys. Chem.*, October.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Electrochemical Units of Measurement.—NERNST.—A full abstract of a paper presented before the Berlin International Congress for Applied Chemistry. In this paper Nernst, as chairman of a special committee of the German Bunsen Society, proposes a table of electrochemical symbols. It was adopted by the congress, together with an amendment of Noyes to appoint an international committee of five, which shall report on this subject to the next congress to be held in Rome in 1906.—*Electrochem. Ind.*, November.

Testing Railway Motors.—ABRY.—In an article of his series on shop testing of motors and generators for commercial service, he deals with tests of the direct-current series railway motor.—*Elec. Rev.*, October 31.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—An article and an editorial on recent legislation of British crown colonies with regard to wireless telegraphy. The result of this legislation is practically to reserve to the government of each of these colonies a monopoly in wireless telegraphy. Not only is the transmission of commercial messages forbidden, except under license, but the actual erection or use of any wireless telegraph apparatus is made illegal unless with express authorization. It is pointed out editorially that to insure an effective system of wireless telegraphy between ships and land an international agreement must be reached.—Lond. *Elec.*, October 23.

Calculator Board.—RAYMOND-BARKER.—Supplementary to a former article describinb an instrument, called a calculator board, he now begins a series of notes in which he shows how to apply the calculator board in practice. The notes are especially written for the use of those officials at cable stations responsible for the routine cable tests and for the localization of any cable breaks that may occur.—Lond. *Elec. Rev.*, October 23.

New Books.

DIE ELEKTROCHEMIE. Industrie und Gewerbe. Ausstellung in Düsseldorf, 1902. Von H. Danneel. Halle: Wilhelm Knapp. 84 pages, 66 illustrations. Price, 6 marks.

This is an amplified reprint of a report published by the author in the *Zeitschrift für Elektrochemie* on the electrochemical and metallurgical exhibits at the exposition held at Düsseldorf in 1902. It contains some interesting information on magnetic separators, the Elmore copper process, and the Goldschmidt thermit process.

BOOKS RECEIVED.

COURS D'ELECTRICITE. By H. Pellat. Paris: Gauthier-Villars, 2 volumes. Vol. I, 329 pages, 145 illustrations. Vol. II, 522 pages, 221 illustrations. Price, 28 francs.

FRICTION AND LUBRICATION. By William M. Davis. Pittsburg: The Lubrication Publishing Company. 225 pages, 60 illustrations. Price, $2.

A New Apparatus for Making Direct Reading Measurements of Electrical Conductivity.

BY WM. HOOPES.

ABOUT three years ago the writer was confronted with the problem of accurately determining the conductivity of 100 or more samples of wire in each single working day, and as this appeared impossible with any form of apparatus then on the market, necessity compelled the construction of a special piece of apparatus

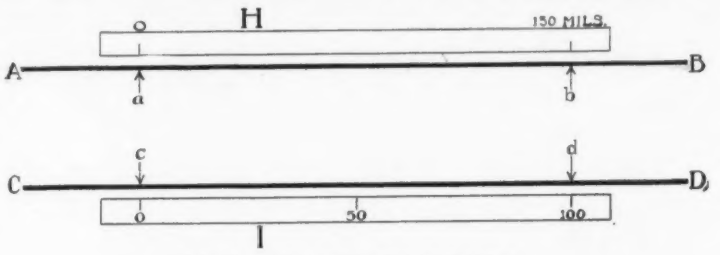


FIG. 1.—ARRANGEMENT OF SCALES.

which would permit the result to be obtained. Accordingly, I designed and had made for the Pittsburg Reduction Company a new form of apparatus for measuring the conductivity of aluminum. This piece of apparatus has been in continuous service since. The arrangement by which it is made direct reading is, I believe, new. As the same arrangement can be used for the measurement of conductivity of copper, iron and other metals, and as it saves a large

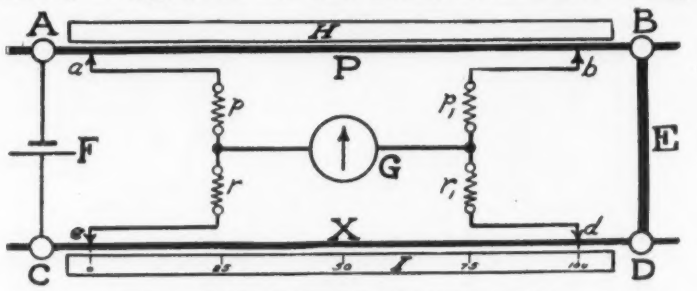


FIG. 2.—DIAGRAM OF KELVIN DOUBLE BRIDGE.

amount of time in making these measurements, I believe that a description of it will be of interest. As I have designed it, it is arranged to make the measurements on short samples of rods or wires about 38 in. long. The arrangement of the scales which makes the apparatus direct reading may be explained by referring to Fig. 1.

A B represents a standard conductor and *C D* a sample conductor, the conductivity of which is to be determined; *a, b, c* and *d* are contacts which make contact at any point on the conductors. The

apparatus requires, in addition to what is shown in the figure, some means of determining when the resistance of the portion *A B* between the points *a* and *b* is equal to the portion *C D* between the points *c d*. As this may be done in several ways, and as it has nothing to do with making the apparatus direct reading, I shall reserve a desription of what I consider the best method until later. The arrangement of the scales can best be illustrated by an example The scale *I* is in all cases the same and is divided into 100 equal parts. Assume the wire, *C D*, to be soft copper and to have a diameter of 150 mils. The length of 100 divisions on the scale *I* of this wire would have a certain resistance in ohms if the wire were at a temperature of 20° C. and were 100 per cent. conductivity, Matthiessen standard. Call this resistance *R*. The wire *A B* is then to be made of the same material and of such a size that a length of it having the resistance *R* at 20° C. will come on the scale *H*. A division is made on the scale *H* and marked 150 mils at such a position that the resistance of *A B* between *o* and this division is *R* at 20° C. To make a conductivity reading, the wire, *C D*, being 150 mils in diameter, the points *a b* are set at zero and the 150 mils mark, respectively; the point *c* is set at 0 and the point *d* is moved until the indicating device shows that the resistance between *c* and *d* is equal to that between *a* and *b*. If *C D* is 100 per cent. conductivity, *d* will obviously come to rest at 100 on the scale *I*, and this will be the case whatever temperature the two wires have, provided only they have the same temperature. If, however, the conductivity of *C D*, is less than 100 per cent., the point *d* will come to rest nearer 0, as *C D* will have a higher resistance and a shorter length of it will equal *a b*. The amount which the contact *d* moves toward 0 will be exactly proportional to the increase in resistance, and consequently to the decrease in conductivity. If the conductivity of *C D* is 98 per cent., then 98/100 of 100 divisions will have exactly the same resistance as 100 divisions of 100 per cent. conductivity.

The apparatus is consequently direct reading for copper wires 150 mils in diameter. To make it so that it can be used with other size wires, other points must be laid off on the scale *H*. For instance, a wire of 300 mils diameter would have four times the cross section of a wire of 150 miles diameter, and consequently a length of it of 100 divisions on the scale *I* would have only ¼ the resistance of the 150-mil wire. The point 300 on the scale *H* would consequently have to be chosen so that the resistance between it and 0 is ¼ that of the resistance between 150 and 0. In the same way a large number of other points may be laid off on the scale *H*, so as to make a single standard wire serve for a range of sizes of sample wires. I have found a length of 25 in. for the scales *I* and *H* satisfactory in practice. Using these lengths, I have not considered it advisable to make the scale *H* cover such a wide range as the above example would indicate, as short lengths on the scale H would require too great refinements of the apparatus to make the length measurements to the required degree of precision. I have considered it advisable not to extend the graduation much nearer to 0 than the middle point of the scale. This obviously makes a single sample wire and its scale cover a range of sizes from a cross section corresponding to the outer point of the scale to a cross section twice as great corresponding to the middle point of the scale. In other words, a single scale could be used for wires having a cross section *n* circular mils to wires having a cross section *2n* circular mils; this is the same as covering a range of three numbers on the Brown & Sharp scale. I have found it advisable to extend the graduations slightly so that in a series of standard wires their scales will slightly overlap and they may thus be compared among themselves.

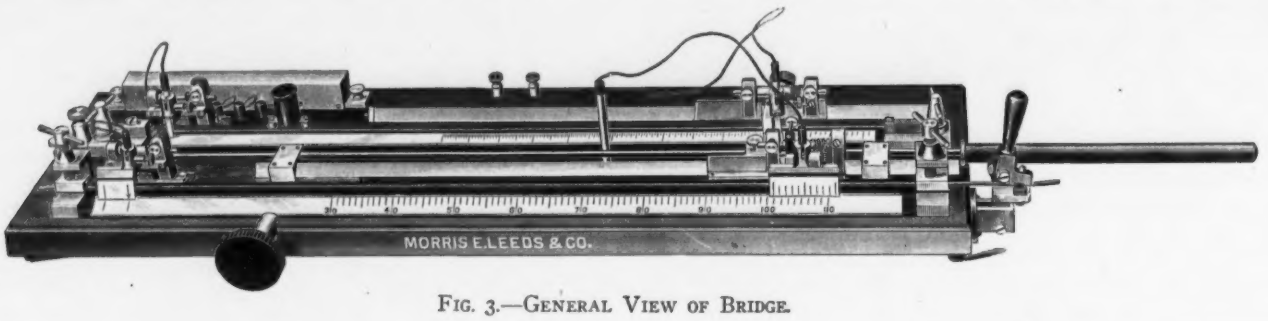


FIG. 3.—GENERAL VIEW OF BRIDGE.

In practice it is troublesome to determine accurately, by measurement, the cross section or diameter of a wire 25 in. long, as a number of measurements have to be made and the average taken. It is usual to determine the cross section by weighing a piece of known length and from a known or assumed specific gravity calculate it. To avoid this calculation, I have made use of the following simple expedient: A cutting-off machine is used which cuts off all of the samples to a definite length. These pieces are then weighed and their weight recorded. The scale *K* is graduated in weights instead of diameters or cross sections. Having determined the weight of a sample, cut off to the proper length, its conductivity is measured by the following simple operations: First, put the sample in the position *C D*. Second, set *b* at the position marked with the weight of sample in grams. Third, move *d* until the galvanometer shows a balance. From the position of *d* the conductivity is read off directly from the scale.

The arrangement that I have adopted for showing that the resistance of the portion of the conductor *A B* between the contact points, *a* and *b*, is equal to the resistance of the portion of the conductor, *C D*, between the contact points, *c* and *d*, is the well-known Kelvin Double Bridge. It is illustrated in diagram in Fig. 2. In this figure *p* and $p_1 r$ and *r* represent three accurately adjusted equal high resistances. *P* and *X* represent the resistance of the conductors between the contact points, *a* and *b*, and *c* and *d*, respectively. By the theory of the bridge, $P \div X = p \div r = p_1 \div r_1$ if there is a current flowing and the galvanometer shows no deflection. As the resistances p, p_1, r and r_1 are made equal to each other, a galvanometer balance shows that $P = X$. Provided the ratio coils are accurately adjusted, errors due to contact resistances are the only ones that can occur. To prevent these the resistances p, p_1, etc., are made high

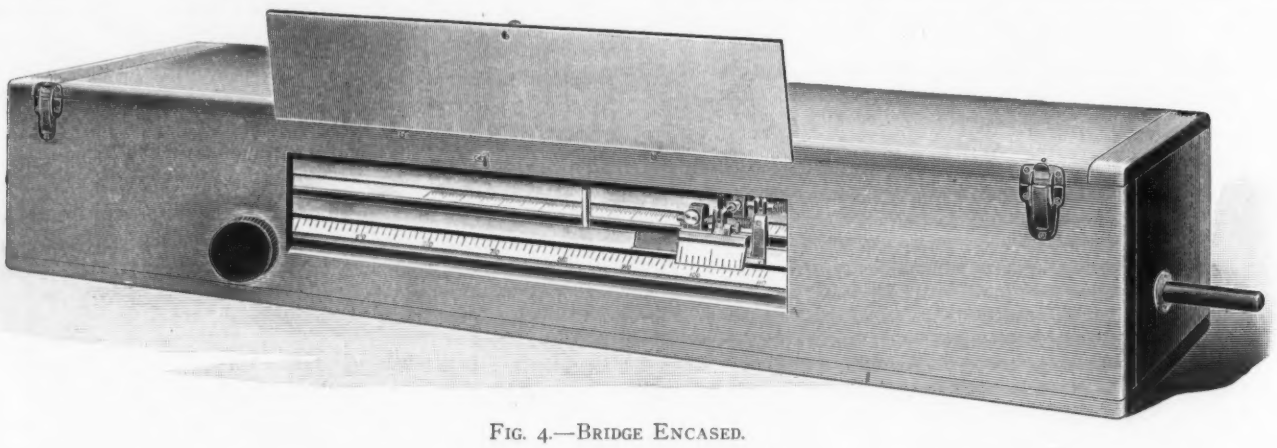


FIG. 4.—BRIDGE ENCASED.

so that contact resistances in series with them will not seriously influence the total. It will be observed from the arrangement that these contact resistances do not figure at all into the resistances of the standard or test piece, but only figure into the resistance of the ratio coils, and even there the error is only due to the difference in contact resistance. There is no objection to making the resistance of these ratio coils high, as the apparatus remains amply sensitive when a proper galvanometer is selected, and does not in any case require the use of a sufficiently large current to heat the standard or sample enough to introduce errors.

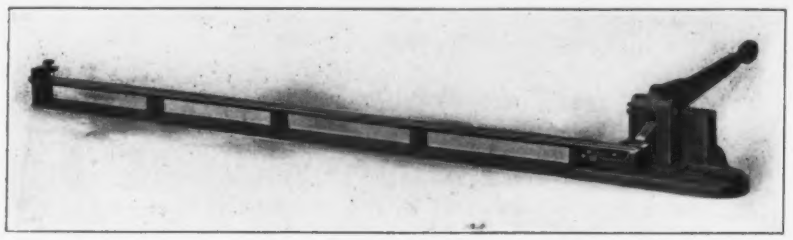


FIG. 5.—WIRE CUTTING MACHINE.

The apparatus was made for me by Morris E. Leeds & Co., now the Leeds & Northrup Co., of Philadelphia. In the following figures the form in which it has been made up is shown. The details of the design were all made by the manufacturers. Fig. 3 shows the bridge. The standard conductor is shown in the back and the two contacts on it are made by means of knife edges; one remains set at the zero position and the other slides up and down, so as to take any position on the scale. By a special locking device, the latter is arranged so that it cannot be moved along the standard except when the knife edge is raised. This is arranged to prevent wear on the standard. The sample wire is clamped in the front and also has two knife edges making contact on it, one at the zero position, which remains fixed, and the other at the other end, which is movable. Wires which are not perfectly straight can be stretched straight by means of the device shown at the right-hand end. The long rod also projecting from the right-hand end is used to give large movements to the contact knife edge, and the handle projecting from the front towards the other end works a rack and pinion which gives it small movements. The exact position of the knife edge is read by means of a vernier and is easily readable to 1/10 of 1 per cent. and estimated to 1/20 per cent. In order to keep the two wires at the same temperature, the entire apparatus is enclosed in a case which is lined with metal and which is shown in Fig. 4. The two handles for operating the movable knife edge of the sample project from this case. The case is lined with metal to prevent errors due to radiated heat. The small door in front which covers a glass opening and is shown open in the illustration, is also of metal. In Fig. 5 the cutting-off machine is shown, by means of which wires are cut off to the definite length of 36 in. A simple form of balance is used for weighing wires to a sufficient degree of accuracy if they are size No. 10 B. & S. gauge or larger. If the wires are smaller than No. 10, they have to be weighed in an analytical balance. As the process requires that they be weighed before they are measured, it is necessary to make the weighing without folding up the wire. This cannot be conveniently done on an ordinary balance, and consequently a special arrangement has been adopted. One of the scale pans of the balance is replaced by a thin walled tube, which projects out of the top and the bottom, and which hangs from the top of the case when the balance is in the arrest position. With this arrangement it is a simple matter to weigh wires to the required degree of accuracy.

FIG. 6.—SINGLE STANDARD AND SCALE.

As explained above, the standard wires can only be made satisfactorily to cover a range of sizes represented by three numbers on the Brown & Sharp gauge. If the apparatus is to be used for measuring a large range of sizes, it is consequently necessary that it be made so that the standards can be replaced. This is accomplished by mounting the standard wire and its scale on a piece of hard rubber, which is strengthened with metal. The two ends of the wire are so arranged that when the standard is screwed into place by means of the heavy clamp screws shown in Fig. 3, the electric connections are made at the same time. As any number of these standards may be supplied for a single bridge, it can be used for an extensive range of sizes, and can also be used for wires of different materials. A single standard with its scale is shown in Fig. 6.

The simplicity of the process of making the measurements will be evident from the following directions which cover all of the steps that are necessary. The sample wire is cut off to length in the cutting-off machine, Fig. 5. It is then weighed in one or the other of the balances referred to, depending on its size, and the weight having been noted, clamped into place in the bridge. The movable contact on the standard is set on its scale at the reading taken from the balance. The entire apparatus is then shut up in its case, Fig. 4, and after it has remained there a sufficient length of time for the standard and the sample to assume the same temperature, the movable contact on the sample is adjusted until the galvanometer shows a balance. The metal lid is then lifted and the percentage conductivity can be read directly from the scale, through the glass window.

Induction Motors.

In order to meet the various demands met in power work, the General Electric Company has developed three different types. One of these is distinguished by the characteristic that it has a variable starting resistance inside the motor secondary or armature; the second has a short-circuited armature, and is used with a starting compensator which is connected in the motor primary or field circuit, and the third is like the first-mentioned, but the armature is equipped with collector rings and the resistance is external and can be cut in or out by means of a controller.

The motor with starting resistance in the armature is provided with a short circuiting switch placed in such a position that at starting all the resistance is included in the armature circuit. As the motor increases in speed, the resistance may be gradually cut out by a movement of the resistance handle. By this arrangement, a large starting effort is obtained with a limited starting current. The starting resistance is of simple and rigid construction, and occupies only a small space within the armature spider. It is so designed as to give a maximum starting torque at least 50 per cent greater than the full load running torque with about 50 per cent above full load current. If small starting torque is adequate, the starting current may be proportionally reduced.

When the effect of a large starting current is not objectionable in the line, or when a motor is not required to start with full load, the induction motor with starting compensator may be used. This type of motor has the advantage of greater simplicity in construction. The armature is of the squirrel cage type, consisting simply of bare copper rods, laid in slots which contain little or no insulation. The motor may be started if desired without the usual starting compensator by simply closing the field or primary switch. It will then carry its load up to nearly synchronous speed, but with a first rush of current of six or seven times full load current. In order to cut down the starting current of this type of motor when the maximum starting torque is not required, a starting compensator is used. It is connected between the line and the motor like a transformer, reduces the potential at the terminals of the motor, and consequently diminishes its starting current. For full load torque at starting, this type of motor requires approximately four times full load running current or about four times the current required by the ordinary motor under similar conditions. If, therefore, the starting current must be kept at or below full load current, the motor cannot be expected to exert more than one-quarter full load torque at starting. As soon as the motor reaches its maximum speed, the compensator should be cut out by shifting the switch handle to the running position.

Compensators are equipped with oil break switches and cartridge fuses. These fuses are connected in the line only when the starting switch of the compensator is thrown on the running position. This arrangement insures ample protection to the motor, making an additional switch and fuses for the line unnecessary.

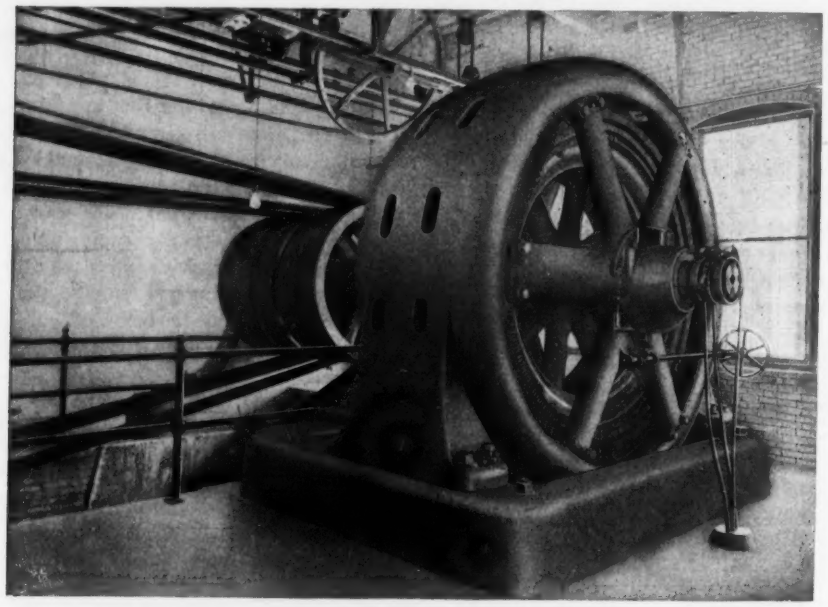
The motor for variable speed is generally used for cranes, hoists, elevators, etc., for the reason that it gives a high power factor and

efficiency at reduced speeds, and particularly excels in having so much smaller losses in the motor itself. Further, its variation in speed for changes in load at lower speeds is small. The rheostat, where most of the losses are concentrated, is external, and therefore readily designed to remain continually in circuit, and to give any variation in speed that could be obtained from a shunt wound continuous current motor with a regulating rheostat in its armature circuit, and with the same efficiency of control.

The variable speed motor with secondary control takes less current from the line at starting, for the same torque, than a motor with primary control. They will give within the limits of synchronous speed and maximum torque, any speed with any torque, depending upon the amount of resistance employed.

In consideration of the intermittent nature of variable speed service generally, and of the fact that the classification of the motor gives its rating on the basis of continuous operation, due allowance should be made in determining the proper motor to be used.

Induction motors for hoisting are designed to have a breaking-down point of not less than three times their rated torque. Taking this into account in connection with the fact that the average hoist does not run over 10 per cent of the time, so that there is no trouble from heating, it will be observed that in general the proper motor to use will be one the rated horse-power of which is the same as the theoretical horse-power of the work. The additional requirements to overcome friction and allow for acceleration are covered by the increase in output made possible by the intermittent service. Slow speed motors are recommended whenever induction motors are to be geared, as in hoisting. This prevents excessive gear teeth speeds with the resultant breakage of gears, and also reduces the power required to accelerate and retard the motor armature.



1000-HP INDUCTION MOTOR.

Induction motors can be constructed for two speeds, half normal speed being obtained by changing from normal to double the number of poles. For the rotor, a short-circuited winding is used. At half speed such a motor will have approximately half its normal capacity.

Large induction motors are in many cases preferable to synchronous motors since they can be operated under conditions where synchronous apparatus would have a tendency to hunt. Induction motors have a greater torque at starting, require no auxiliary equipment with exception of starting device, and consequently can be operated with less attention and less experienced attendance. They are constructed in all three of the types above mentioned. In the larger units, however, it is desirable, even where the resistance is used only for starting, to have it separate from the motor and to use collector rings. Such motors, unless for variable speed, are furnished with a switch inside the armature so that the collector rings can be short circuited after the motor has reached normal speed.

The General Electric Company has manufactured during the past year twenty-two induction motors of 500 hp and over, aggregating 15,600 hp, or an average of over 700 hp each. A motor of 1,000 hp made for the U. S. Rubber Reclaiming Works, is shown in the accompanying illustration.

Form K motors having a double-throw line switch may be started under low voltage from taps on the secondary of transformers instead of employing compensators for this purpose. This arrangement is especially desirable on account of simplicity and cost where several motors are located close to the bank of transformers from which they are operated.

Within the limits of variation found under ordinary conditions, there is no serious objection to either an increased voltage or a reduced frequency, except, of course, that in the latter case the speed of the motor will be reduced in the same ratio as the frequency.

When the voltage is decreased, however, the maximum output of the motor will decrease as the square of the voltage, and when the frequency is increased, the maximum output will decrease approximately as the square root of the frequency.

Christmas Tree Lighting.

The trouble and difficulty incident to wiring a Christmas tree for incandescent lamps has heretofore been the only drawback to their use. To remedy this the General Electric Company has prepared an outfit of sockets and cord connected and completely made up, ready for immediate use. The cord is simply draped over the tree, the lamps placed in their sockets, the connecting plug attached to the nearest electric fixture and the current turned on. All the lamps are instantly lighted and burn without further attention as long as desired. The outfit is light and flexible, thoroughly well constructed and "fool proof."

ELECTRICALLY-ILLUMINATED CHRISTMAS TREE.

Each regular outfit comprises some 50 ft. of flexible cord with tiny sockets, arranged in three branch festoons, and 28 one-candle-power miniature genuine Edison lamps in plain and colored bulbs, sufficient for the average Christmas tree. The outfit is neatly packed in a handsomely decorated wooden box, and forms a safe and charming Christmas gift for any household. Special outfits containing a larger number of sockets for large trees can be furnished when desired. The outfit is of value not only for Christmas trees, but also for general house decoration upon the table, about the walls or around columns, over the balustrade or from chandeliers—at all times and seasons. An outfit once purchased lasts for years and can be used repeatedly with no trouble or further expense. It is believed that if the field of application for such work is investigated by those who are interested in the sale of light, current or supplies, they will find a large and growing demand for such devices as that just noted—whether for Christmas or for any other season.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The continued movement of money to the interior, high rates of interest in the loan market and the unfavorable developments in the steel trade adversely affected the stock market. One of the results was a severe break in prices for United States Steel securities and this influenced both the industrial and general railway list. The transactions were on a small scale and mainly professional. Prior to Tuesday—election day—considerable strength and activity developed in the local New York traction stocks, based on predictions of a change in the municipal administration, but the rise failed to be sustained when the result of the election was determined. Further shipments of money from New York to Western and Southern cities resulted in an estimated loss of some $10,000,000 by the banks. The prevalent rate for call money is about 4½ per cent., and time money ruled at 6 per cent. Boston advices are to the effect that the market there during the week ruled slow, with a general easier tendency. The week's closing prices of tractions showed a gain of ½ point for Brooklyn Rapid Transit, which closed at 35¾ after having recovered from 34½, the lowest figure, the highest being 37½. Metropolitan Street Railway closed at 109, this being a net loss of ¾ point. Manhattan Elevated made a gain of 1¼ points, closing at 136½, which was ¼ below the highest figure of the week, the lowest being 134¼. General Electric fell to 146, but closed at 147, this, however, being a net loss of 1½ points; the highest quotation was 152¼. Transactions in this stock were limited, only 2,125 shares having been sold. Westinghouse common reached 138, but receded and closed at 135, which was the lowest figure of the week and a net loss of 2 points. Western Union made a net gain of ¼ point, closing at 83. Following are the closing quotations of November 10:

NEW YORK.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
American Tel. & Cable	78	78	General Electric	150	148
American Tel. & Tel.	128	125	Hudson River Tel.	..	..
American Dist. Tel.	24	23	Metropolitan St. Ry.	110¾	111½
Brooklyn Rapid Transit	35⅞	37	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	140	N. Y. & N. J. Tel.	..	140
Electric Boat.	20	19	Marconi Tel.	..	..
Electric Boat pfd.	44	42	Western Union Tel.	83	82½
Electric Lead Reduction.	*1⅛	⅛	Westinghouse com.	136	134½
Electric Vehicle.	5⅛	5⅛	Westinghouse pfd.	165	162½
Electric Vehicle pfd.	8	8⅛			

BOSTON.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
American Tel. & Tel	127¾	126¾	Western Tel. & Tel. pfd.	75	75
Cumberland Telephone	..	*115	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum.	244	240	New England Telephone	*123¾	123
General Electric	150	146	Mass. Elec. Ry.	18¾	18½
Western Tel. & Tel.	8⅛	8	Mass. Elec. Ry. pfd.	77½	76

PHILADELPHIA.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
American Railways	43	42	Phila. Traction	95¼	95⅛
Elec. Storage Battery	47	45	Phila. Electric	6⅛	6
Elec. Storage Battery pfd.	47	45	Phila. Rapid Trans.	12	11¾
Elec. Co. of America.	7⅞	7⅞			

CHICAGO.

	Nov. 4	Nov. 10		Nov. 4	Nov. 10
Central Union Tel.	..	..	National Carbon pfd.	..	86
Chicago Edison	140	140	Metropolitan Elev. com.	17	17
Chicago City Ry.	167	165	Union Traction	6	5¼
Chicago Tel. Co.	115	120	Union Traction pfd.	30	29
National Carbon	17¾	20			

*Asked

CHICAGO LAKE STREET L.—A reorganization of the Lake Street Elevated Railroad Company has been made and will be carried out as soon as practicable. A new company with a new name is to take over and operate the property. The new company will be capitalized as follows:

	New.	Old.
Stock, common	$6,000,000	$10,000,000
Stock, preferred	3,200,000	.....
First mortgage bonds	5,000,000	5,860,000
Income bonds	.....	1,023,500
Totals	$14,200,000	$16,883,550

The plan of reorganization sets aside $2,000,000 of preferred stock, $2,000,000 of common stock and $500,000 of treasury bonds, the proceeds of which with the $200,000 assessment paid by the stockholders on the basis of $2 per share, will be used for paying the indebtedness of $1,400,000. The Northwestern Elevated Railroad Company has agreed to accept a settlement of its claim of $770,000, a debenture note of the company for $350,000, payable in five years, with 2 per cent. interest. In consideration of the reduction of the bonds from $5,860,000 to $5,000,000, the bondholders will be requested to present their bonds to have stamped upon them that fact, and also a provision that they may be redeemed by the company on any interest pay day, at 105 with accrued interest. The $3,200,000 of preferred stock will go to the income bondholders to the amount of 80 per cent. of the par value of their bonds. The existing stock of a face value of $10,000,000 is to be wiped out. In its place will be issued $6,000,000 of common stock and $3,200,000 of preferred stock.

LIGHTING IN NEW JERSEY.—The Public Service Corporation, of Newark, N. J., has arranged for the purchase of all of the stock of the Central Electric Company, which is located at Metuchen, and which supplies light and power to that town besides the municipalities of New Brunswick, Perth Amboy, Rahway, Woodbridge, Raritan Township, Carteret, Bound Brook, Dunellen and South Plainfield. The purchase price of the stock is quoted at $17.50 per share. The Central Electric Company has a capitalization of $750,000, together with an issue of bonds aggregating a like amount. The bonds are 5 per cent. first mortgage gold bonds, secured by a consolidated mortgage on all the property of the company, and are payable in forty years from July 1, 1900. The Central Electric was organized a few years ago by the consolidation of the Middlesex Electric Company, the Edison Electric Illuminating Company, the Raritan Electric Light & Power Company, the Rahway Electric Company, and the Bound Brook Electric Light, Heat & Power Company.

MICHIGAN TELEPHONE COMPANY.—A dispatch from Detroit, Mich., states that the Michigan Telephone Company was purchased on November 4 at foreclosure sale by N. W. Harris, of Chicago, for a syndicate of bondholders of the company, for $4,100,000. The only other bidder was Gen. E. P. Meaney, of New York, representing the American Telephone & Telegraph Company, who bid $4,000,000. The upset price for the property was $2,500,000. George W. Harriman, of Boston, the dispatch adds, made formal protest against the sale in behalf of himself and other stockholders, declaring that he believed the plant was being sacrificed. The Michigan company was the subsidiary company of the Bell system in the State of Michigan. It is stated that the interest has been due for a year on $5,000,000 first mortgage bonds.

GERMAN ELECTRICAL OUTLOOK.—A leading New York house is said to have just sold in Berlin a block of stock of the Schuckert Company, one of the leading electric concerns in Germany, at 114½. A year ago this stock sold around 75. The advance illustrates the revived confidence in German circles.

CAMBRIDGE (MASS.) STOCK INCREASE.—The stockholders of the Cambridge Electric Light Company, at a special meeting, have voted to increase the company's capital stock from $600,000 to $700,000 by the issue of 1,000 shares of new stock.

Commercial Intelligence.

THE WEEK IN TRADE.—On the whole, trade and industry presents a quieter aspect, the unseasonable weather affecting retail trade at many centers, while conservatism in providing for future requirements restricts jobbing trade. Relatively the most activity exists in the South, where the growth of the cotton movement at the high prices ruling stimulates business at many centers. In industrial lines reports of curtailed production indicate that demand is somewhat lagging. Railway earnings are feeling the effects of smaller receipts of wheat, but still they show increases over all preceding periods at this date. Prices display an easier tendency except for cotton, which is at the highest level reached for many years at this season. Finished iron and steel head the downward movement of manufactured goods, but there are signs of reawakening in the foreign and domestic demand, which, it is hoped, will bring about improved conditions. President B. F. Jones, Jr., of the Jones & Laughlin Steel Company, of Pittsburg, states that consumers have been holding off for some time expecting a reduction in prices. Rock bottom having now been reached, he looks for an immediate revival in the trade, and a resumption of all the mills to their full capacity. It is officially announced that the only changes in the prices made at the recent New York conference were in Bessemer steel billets, which were reduced from $27 to $23 a ton, and steel cars from $32 to $26 a ton. Finished products remain unchanged. After an idleness of five or six weeks about 2,000 men have resumed work in the McKeesport mill district. The commercial failures during the month of October

were more numerous than in any month since January last, and the heaviest for October since 1893. They numbered 1,086, the liabilities aggregating $18,387,567. Manufacturing failures numbered 316 with an aggregate of $11,995,369 in liabilities, and the trading failures numbered 720 with liabilities of $5,536,129. The heaviest increases of failures in commercial enterprises were in iron, foundries and nails. In commenting on the above record, R. G. Dun & Co. point out that it is encouraging that the abnormal big commercial liabilities last month were largely provided by a few failures. Less than 3 per cent. in number accounted for about 54 per cent. of the defaulted indebtedness. The number of failures for the week ending November 5 aggregated 216, against 217 the week previous, and 148 the corresponding week last year. The copper market was quiet but firm throughout the week, a fair amount of business having been transacted. Inquiry from Europe continues quite brisk. The closing quotations are 13½ to 13¾c. for Lake, 13¼ to 13½c. for electrolytic, and 13 to 13¼c. for cathode and casting stock.

MORE POWER PLANTS NEEDED.—In February the New York State Railroad Commission investigated the matter of improving the condition of passenger transportation in New York City. In June the commission made a report of its investigations. It has now made a second report with reference especially to the capacity of the electric power houses of the several street railways. The report says that lack of foresight in providing for increased business has been shown by the Brooklyn Heights, the Coney Island & Brooklyn, the New York & Queens County, and the New York & North Shore Companies. "The Manhattan Elevated road," says the commission, "has not sufficient power of its own to fully and reliably operate its lines; it has, however, made arrangements with other companies to secure a necessary supply. The Metropolitan Street Railway (Interurban) and the Union Railway have an ample supply of power to operate more than the maximum number of cars now in use. The Brooklyn Heights Company, operating most of the surface and all the elevated lines in Brooklyn, has not sufficient power to operate the requisite number of cars for the accommodation of the public." The commission gives statistics showing a great and rapid increase of traffic on nearly all the lines operating in New York and Brooklyn. Arrangements have been perfected by all except the New York and Queens County to provide power for the operation of an increased number of cars. The report says that prolonged strikes have delayed the completion of power houses and the securing of the necessary machinery.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the "chloride accumulator," has recently closed a contract through the Canadian General Electric Company, Limited, its representative in Canada, for an installation in the power house of the Toronto Railway Company. This battery, to be used on its system, consists of 276 cells having a capacity of 3,000 amp. for regulating. A contract has also been closed with the Bangor Public Works, Bangor, Me., for a railway battery consisting of 264 cells having a regulating capacity of 160 amp. This battery has containing cells of sufficient capacity to allow of a future increase of 50 per cent. The Carnegie Steel Company has contracted for the installation of a battery at its Youngstown (Ohio) works for use in regulating the violent fluctuations of load due to the starting and stopping of motors, this battery having a capacity of 1,600 amp. at 260 volts. The Chicago Edison Company has contracted for a battery for its Haddock Place station having a capacity of 16-800 amp.-hours at 128 volts. Contracts have also been closed with the United States Government for a battery at Fort Totten, consisting of 62-640 amp.-hour cells, the Stevens Building, Detroit, Mich., 140-160 amp.-hour cells, the House of the Good Shepherd, Roxborough, Mass., 62-160 amp.-hour cells, and Johnson-Kahn Company, 68-560 amp.-hour cells, these latter installations being for lighting and power work.

WIRELESS TELEGRAPH CONTRACTS.—We are informed that the "Telefunken" Company for wireless telegraphy, of Berlin, has received another large order from the United States Navy, for the equipment of ten more ships. The United States Navy will, therefore, have in a short time more than 60 stations of this system. The station equipment last ordered will be shipped directly to Eastern Asia in order to be installed on board the ships of the American navy stationed there. It is to be assumed that in this way a larger number of stations for wireless telegraphy will be formed at the coast and in the interior of eastern Asia. The company mentioned is very active at present in the sea north of Germany, to equip all light ships with apparatus for communication with the coast stations of the German navy. The Swedish navy has also adopted the Telefunken system and operates at present more than 20 stations. This year's naval manœuvres have given satisfactory results with respect to the reliability of the system and the distance of the transmission of messages, so that the equipment of further stations is expected.

MAGNETIC SEPARATION OF ORES.—We have received the following from the Maschinenbau-Anstalt Humboldt, of Kalk, near Cologne: "Our attention has been drawn to an extract appearing in your issue of the 1st of October under the heading, 'Magnetic Separation of Ores—Fabre,' and we should not like to let this pass without pointing out that it does not quite correctly describe the situation, as we, the above-named company, have taken over the management of the Wetherill business which was formerly in the hands of the owners, the Metallurgische Gesellschaft, of Frankfort, of the Wetherill patents, by arrangement with the European Wetherill syndicate. In our works we have a perfectly-arranged testing station, which can be placed at the disposal of people interested. The Wetherill separators are manufactured in our works, and we have already fitted up a large number of plants with them."

POWER FROM THE OHIO.—A special dispatch from Cincinnati of November 9 says: "Leading electricians from all parts of the country were in conference here this afternoon over the proposition to utilize the falls in the Ohio River at Louisville for power for traction, electric light and other plants throughout Indiana, Kentucky and Ohio. The Philadelphia syndicate which controls the traction lines in Cincinnati, Indianapolis, and other parts of Ohio and Indiana has had experts examining into the feasibility of the plan for some time, and they have reported favorably. At Louisville to-morrow the engineers who were here to-day will confer with government engineers before taking the matter up with Congress."

PELTON WATER WHEEL CONTRACT.—The Edison Electric Company, of Los Angeles, has recently contracted with the Pelton Water Wheel Company, of San Francisco, for two 500-hp water wheels to drive electric generators in the new station on Lytle Creek, near Redlands. This makes the fifth hydraulic station of the Edison Company. The wheels will work under 480-ft. head and will be equipped with needle regulating nozzles, adjustable by hand, and leather-packed ball joints, operated by governor. The generators will be two General Electric machines, taken from another plant, and will operate at a speed of 375 r.p.m. The contract also calls for two exciter water wheels.

CANADIAN WESTINGHOUSE COMPANY.—A Canadian correspondent writes that work is being rapidly pushed upon the factory of the Canadian Westinghouse company at Hamilton, Ont., which will give employment to 1,000 men. The American company, he states, has upon its books, at the present time, unfilled contracts and orders for Canada of upwards of $750,000 worth of electrical apparatus. Until the completion of the works at the city of Hamilton electric apparatus for the Canadian market will be manufactured at Pittsburg, Pa., but will be sold through the agents of the Canadian company.

C. & C. MOTOR ORDERS.—The C. & C. Electric Company reports a considerable picking up in the demand for small motors for clothing manufacturing plants, etc., in New York. Three C. & C. motors varying from 8 hp to 40 hp, are to be installed in the new Rogers Building, Fourteenth Street and Sixth Avenue. The motors will be used for operating Sturtevant ventilating apparatus. An order has been secured from Australia for small motors, which are to be utilized for driving the printing presses of the *Sydney Bulletin*.

ELECTRIC ELEVATORS.—The *New York Times*, in its new building on West Forty-second Street, is putting in five passenger and two freight elevators, all electric, furnished by the Otis Elevator Company. The passenger cars will each have a carrying capacity of 3,000 pounds and will travel at a speed of 500 ft. a minute. One will be equipped with a special gearing by means of which it will be enabled to handle the safes which come into the building. This elevator will be capable of lifting a safe weighing 6,000 pounds.

THE WAGNER-BULLOCK ELECTRIC COMPANY, of San Francisco, has been awarded the contract for generators and other equipment for the Cedar Falls Light & Power Company, for $17,-685.80. Former bids had been rejected because several had failed to cite samples of machinery in successful use for a longer period than six months. The Wagner-Bullock Electric Company agrees to have part of the equipment installed within five and a half months' time after acceptance of its bid.

BRAZILIAN LIGHTING AND POWER PROJECT.—South American advices state that E. Gandolfo & Co., of Rio de Janeiro, are primarily interested in a project to erect a large plant in the Brazilian capital for the purpose of generating current for light and power use in Belgrano, Saavedera, Villa Mazzini, Villa Devote and General Urquisa, all suburbs of Rio.

ENGINES FOR NEW LONG ISLAND POWER HOUSE.—Two 20-in. x 40-in. x 42-in. tandem compound engines are to be installed in the new plant at Rockville Center of the New York & Long Island Traction Company. The contract was secured through the New York office of the C. & G. Cooper Co.

BALL ENGINE CONTRACT.—The Presbyterian Hospital, New York City, has ordered from the Ball Engine Company, Erie, Pa., two direct-connected units, one of 135 hp and one of 100 hp.

General News.

THE TELEPHONE.

OSCEOLA, ARK.—Two switchboards of 150 drops capacity each are in operation at the exchange of the Tri-State Telephone Company, which has 200 subscribers. The company owns 150 miles of toll line, and it is its purpose to build 20 more miles of metallic copper toll line and 30 miles of metallic iron. It may put in an automatic exchange in addition next year.

LONE ROCK, ARK.—Mr. E. A. Faris, manager of the Batesville & Winnerva Telephone Company, informs us the outlook is most promising, that the country has just been opened up by a new railroad, new towns are springing up and being settled rapidly and the old towns are growing. An additional exchange and 100 miles of toll line are planned for early erection.

ATLANTA, GA.—An up-to-date system of underground police and fire alarm wires is being completed in Atlanta.

AUGUSTA, GA.—The Strowger Automatic Telephone Company, of Augusta, has completed a connection with the Wilkes Telephone Company, giving an enlarged out-of-town service.

WASHINGTON, ILL.—The Washington City Rural Telephone Company has been incorporated; capital $10,000. Incorporators: George M. Myers, Paul G. Goddard and E. Garber.

STAR CITY, IND.—The Star City Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $50,000. The incorporators are William L. Bott, George L. Buck, Michael Fuff, N. A. Murphy and J. L. Lowrey.

INDIANAPOLIS, IND.—Long distance telephone lines reaching through northern Indiana as well as local lines were considerably inconvenienced and put out of service for several hours Oct. 31 by earth currents coincident with the appearance of sun spots.

COLUMBUS, IND.—Fire damaged the exchange of the Citizens' Telephone Company. Several lines in the country were burned out and the cable containing over one hundred city lines was burned in two. These lines will all be out of service until a new cable can be installed.

BATESVILLE, IND.—The Batesville Telephone Company has completed its organization and filed articles of incorporation with the Secretary of State. The capital stock is placed at $5,000. August Bloenner, John W. Wilker, George A. Bass and E. C. Timmerman are the promoters.

INDIANAPOLIS, IND.—S. P. Sherrin, president and general manager of the New Long-Distance Telephone Company, is the recipient of much praise for having permitted the use of the company's wires free of charge to the friends of the 15 foot-ball students killed in the recent railway wreck in this city. By means of these wires the families of the unfortunate athletes were immediately communicated with in various parts of the state.

VINCENNES, IND.—The City Council has threatened to repeal the ordinances granting franchises to the Central Union Telephone Company and the Knox County Home Telephone Company for a refusal or failure to furnish the National Rolling Mill Company, of this city, with telephone service. The rolling mill company employed non-union men to build its plant and the union men employed by the telephone companies refused to run the wires or place the telephones in the rolling mill offices. The couucil takes the view that a refusal of union men to place telephones is not a sufficient excuse and resolved that it would be the policy of the city to look to the bonds of the telephone companies on file with the city, for all reparation occasioned by the failure of the telephone companies to place telephones in offices of the rolling mill company, upon proper application. The council takes the ground that the companies must give the service or forfeit their franchises.

DETROIT, MICH.—The Michigan Telephone Company has been purchased at foreclosure sale by N. W. Harris, of New York, for a syndicate of bondholders of the company for $4,100,000. The only other bidder was General F. P. Meaney, of New York, representing the American Telephone & Telegraph Company, who bid $4,000,000. George W. Harriman, of Boston, made a formal protest against the sale on behalf of himself and other stockholders, declaring that he believed the plant was being sacrificed.

STILLWATER, MINN.—The Northwestern Telephone Exchange Company has commenced the operation of its new system.

HALLOCK, MINN.—Swanson and Halvorson, of Warren, Minn., have bought the local telephone exchange here and will make improvements.

NEBRASKA CITY, NEB.—The Nebraska City Telephone Company has increased its capital stock from $50,000 to $100,000.

OMAHA, NEB.—The Postal Telegraph Company is building a line between Omaha and Denver along the Union Pacific Railway.

DEMING, N. M.—The Luna County Telephone & Improvement Company has been organized here with a capital stock of $100,000 for the purpose of establishing and operating a complete telephone system in this city. The incorporators are Sigmund Lindauer, Newton A. Bolich, Frank Du Launey and John J. Jeffries, all of Deming.

NUNDA, N. Y.—The Nunda Telephone Company will construct a line to Dalton and another to Brooks Grove. The company has just completed four lines in the town of Portage, and 25 subscribers have been connected therewith.

ASHEVILLE, N. C.—The city board of Asheville has passed the ordinance merging the Citizens Telephone Company into the Southern Bell Telephone Company. There was much opposition on the part of the citizens.

ZANESVILLE, OHIO.—The Woodsfield Telephone Company is rebuilding 50 miles of toll line and putting in cable additions. It will build six miles of new toll line this fall and improve the system generally; and will also build an exchange at Beallsville, Ohio. The Dayton exchange has grown from 150 subscribers in 1902 to 275 at the present time. Its rates are $12 and $15.

BLUFFTON, OHIO.—A 300-drop Eureka board, and North and Swedish-American instruments are in use at the exchange of the Bluffton Telephone Company, which has at present 420 subscribers, 128 of which were added in the last 11 months. The rates charged are $12 and $24 per annum. Mr. O. G. Snyder, manager, informs us that a few rural lines and one toll line are projected, and that the outlook seems fair for an increase next spring. The company has practically all the farms within a radius of from four miles north to nine miles west, east and south, one sub-station and twenty-eight telephones, all metallic toll and party lines through the country.

GUTHRIE, OKLA.—The lamp signal system is now being installed by the Guthrie Telephone Company. Ericsson apparatus is used. There are 750 subscribers, with 150 more to connect.

KINGFISHER, OKLA.—A new office is being built for the telephone exchange at Kingfisher, owned by Mr. W. J. Steele, who contemplates installing a new Kellogg switchboard. Service is furnished to 255 subscribers.

PERKINS, OKLA.—About 30 miles of rural lines are projected by the telephone exchange owners at this place,—Messrs. J. M. Boone & Sons. The system comprises 25 subscribers, with good prospects for an increase in this number.

PONCA CITY, OKLA.—The Pioneer Telephone Company, through the local manager, Mr. E. A. Hildebrand, informs us that its outlook is very good, that it is offered more business than they can handle. Three hundred miles of toll lines have recently been built. At Ponca City there are 300 subscribers, Ericsson apparatus being used.

WOONSOCKET, S. D.—The Woonsocket Telephone Company uses Standard Telephone & Electric Company's telephones. It has 128 subscribers.

SALEM, S. D.—A 200-drop Western Telephone Mfg. Company's switchboard is operated by the Salem Telephone Company which has 117 subscribers.

SCOTLAND, S. D.—Ninety subscribers are furnished with telephone service by the People's Telephone Company which uses instruments manufactured by the Standard Telephone & Electric Company.

MITCHELL, S. D.—One hundred subscribers were added to the list of the Mitchell Telephone Exchange this year, making 375 at the present time. "Eureka" apparatus is used. The company reports a steadily increasing business and a good outlook.

DEADWOOD, S. D.—The Nebraska (Bell) Telephone Company has completed the laying of conduits, having constructed four or five miles of conduit along the principal streets, with laterals extending along the alleys and side streets to reach distributing poles.

MARYVILLE, TENN.—There are 165 patrons of the Maryville Telephone Exchange, and about 150 miles of toll line. This is a mutual exchange, and the outlook is good for a steady growth.

MARTIN, TENN.—A gain of about 40 telephones a year is the record of the Weakley County Telephone Company, which has at present 240 subscribers. The charges are $1.25 for residences and $2.25 for business per month.

MEMPHIS, TENN.—The Memphis Telephone Company reports a most encouraging outlook. The company began business in August, 1902, and now has 3,100 subscribers, with 40 miles of toll line of which it is building more. The charges are $2.50 for residence and $4 for business service.

NEWPORT, TENN.—The Newport Telephone Company now has connection with Asheville, N. C., and is building an exchange in Greenville, Tenn. When the latter is completed, it will be connected with all towns from Knoxville, Tenn., to Lynchburg, Va.

MORRISTOWN, TENN.—It is planned to build a number of new toll lines by the Citizens' Telephone Company. This company expects soon to have connection with Chattanooga and Bristol (Tenn.) through the intervening independent telephone companies. It has 230 subscribers in Morristown and 70 outside of that place. Mr. Thomas N. Horner is secretary and treasurer.

TRACY CITY, TENN.—There are 294 subscribers to the Dixie Telephone Company which operates a 300-drop American Electric switchboard. Mr. K. A. Banholzer, the general manager, states that several large coal companies are preparing to open up within ten miles of Tracy City and build new towns, and the Dixie Company is preparing to supply them with telephones as they may need them.

SMITHVILLE, TEX.—A telephone company is being organized here for the purpose of installing and operating a local exchange. S. L. Staples can give information.

COMMERCE, TEX.—The Commerce Telephone Company is making part of its toll lines, of which there are some 55 miles, metallic, and is extending and increasing the exchange at Commerce, which has 140 subscribers.

CENTER, TEX.—The Sabine Valley Telephone Company, Mr. W. A. King, manager, has 115 subscribers at Center. The company has 150 miles of toll lines and plans to build 50 miles more.

AMARILLO, TEX.—The installing of a larger switchboard is under consideration by the Amarillo Telephone Exchange which has 290 subscribers, paying $3 for business and $1.50 per month for residence service.

BEAUMONT, TEX.—The Beaumont Telephone Company has 850 subscribers, and an increase to the full cable capacity—1400—is looked for. It charges $3 and $2 a month. Stromberg-Carlson instruments are employed.

BIG SPRINGS, TEX.—General Manager C. L. Alderman, of the Western Telephone Company has connections with 800 miles of toll lines, and toll lines to the extent of 214 miles are under contemplation. Kellogg apparatus is used. The company has 210 subscribers.

COLEMAN, TEX.—A toll line from this place to Burkett, 20 miles, is projected by the Coleman Telephone Exchange. This system has recently passed

from the ownership of Mr. D. W. Watson to Mr. R. G. Hollingsworth. Wire has been ordered for some ranch telephones 12 and 15 miles from town, in addition to the Burkett line.

ABILENE, TEX.—The Roberts Telephone & Electric Co. operates a 300-drop Kellogg switchboard and a 100-drop Connecticut Tel. & Elec. switchboard, and numbers at present 375 subscribers, who pay $3 per month for business, $1.50 per month for office and $1 per month for residence service. The company has recently added 30 miles of toll line and contemplates adding 15 miles more. Mr. C. W. Roberts is president and general manager.

WARRENTON, VA.—An addition of 20 miles of toll line and 25 subscribers are in prospect by the Warrenton Telephone Exchange, which now numbers 120 subscribers, using "Sumter" apparatus. The company writes that the demand for telephone service is beyond its expectations and is taxing its resources to keep up with the growth.

LYNDEN, WASH.—Local business men are forming a company to install a telephone exchange here.

DODGEVILLE, WIS.—The Wisconsin Telephone Company is building a line between this city and Madison.

ST. CROIX, WIS.—The St. Croix Valley Telephone Company furnishes service to 250 subscribers, operating a 100-drop Standard switchboard.

LODI, WIS.—The Lodi Telephone Company is using at present the grounded system on a metallic board. There are 206 subscribers who pay $1 per month.

PRESCOTT, WIS.—The Prescott Telephone Exchange numbers 118 subscribers, who pay 75c. per month each. Mr. George S. Hollister is manager. "Victor" apparatus is used.

PORTAGE, WIS.—A 500-drop Standard board is operated by the Portage Telephone Company which has 450 subscribers paying $1 a month. An encouraging outlook is reported.

FORT ATKINSON, WIS.—Some farmers' lines are to be built by the Jefferson County Telephone Company, which has 255 subscribers and uses Standard Tel. & Elec. Company apparatus.

SHARON, WIS.—A Sterling 200-drop switchboard, with 120 installed, is operated by the Sharon Telephone Company. Twenty-five miles have recently been added. The charges are $1 and $2 per month.

VIROQUA, WIS.—The Viroqua Telephone Exchange was built in 1897, commenced with 47 subscribers; it has now 260. The outlook for the future is very good, and four farmers' lines are projected.

MONROE, WIS.—A 500-drop Standard switchboard is operated by the Monroe Telephone Company, with its 475 subscribers. Not a rapid but still a satisfactory growth is the report of Secretary Louis A. Hodges.

MAZOMANIE, WIS.—The Mazomanie Telephone Company reports a steady growth and good outlook. It has 200 subscribers and operates 100 miles of toll line. Standard and Kellogg apparatus are here represented.

SPARTA, WIS.—The Monroe County Telephone Company, which has been in operation four years, operates a 220-drop Standard switchboard, and has 220 subscribers and 150 miles of toll line. It is planned to build some farmers' lines.

NEW RICHMOND, WIS.—The Phoenix Telephone Exchange, owned by F. W. Epley, operates a 200-drop "Express" switchboard. It numbers 160 subscribers, who pay $2 per month for business and $1 per month for residence service.

MAUSTON, WIS.—The telephone service at this place is under the control of the Mauston Electric Light & Power Company. There are 285 subscribers, Standard Telephone & Electric apparatus being employed. A good outlook is reported.

GRAND RAPIDS, WIS.—The Wood County Telephone Company is planning to spend $8000 in rebuilding and improving the plant, adding a 100-drop section of board, hanging considerable cable, etc. The 490 subscribers use Stromberg-Carlson instruments.

MERRILL, WIS.—The reconstruction of its entire system has just been completed by the Merrill Telephone Company which bought the poles and lines of the Wisconsin Telephone Company. The subscription list has doubled in two years at Merrill and has now 420 names.

MINERAL POINT, WIS.—The Mineral Point Telephone Company operates at present a 200-drop switchboard of Standard make, but reports that this will probably have to be increased to 400 drops. From 60 subscribers in 1899 to 220 in September, 1903, shows that the company has had a very healthy increase.

ELKHART LAKE, WIS.—An exchange at Chilton, with a 100-drop Stromberg-Carlson switchboard, one at Kiel with 100 drops, another at New Holstein with 25, and a fourth at Elkhart Lake with 50 drops, are operated by the Eastern Wisconsin Telephone Company. The company has a total of 200 subscribers and 220 miles of toll line.

MARSHFIELD, WIS.—The owner of the telephone system at this place, Mr. J. C. Marsh, reports that he has a first-class, up-to-date exchange and fine offices, owing also the building. An increase of 150 during the next two years is anticipated. Three hundred subscribers are supplied with service through the 400-drop Stromberg-Carlson switchboard.

OAKFIELD, WIS.—There are 117 subscribers to the Oakfield Telephone Company, using American Electric apparatus. Mr. W. E. Bristol informs us that it had about 600 messages per month over its line to Fond du Lac where it had, until recently, connection with the Little Wolf River Company, now in the hands of the Wisconsin Telephone Company (Bell).

RHINELANDER, WIS.—The system of the Rhinelander Mutual Telephone Company is full metallic central energy and is giving the best of satisfaction. The Bell Company has had to take down its wires. A 400-drop American board is operated, on which 375 connections are made. The company has just installed 3750 feet 50-pair and 1000 feet 25-pair cable, and contemplates installing more cable.

RACINE, WIS.—During the past year the Racine Telephone Company has increased its subscription list by 500 names, and has now 1700 subscribers. This increase has come without the aid of a solicitor. It is expected to show during the coming year a similar increase to that of the past twelve months. An exchange has recently been started at Kenosha, Wis., and the Racine Company will have connection to that city, which has a population of 20,000. Sterling apparatus is used.

LACROSSE, WIS.—Mr. H. M. Rounce, manager, LaCrosse Telephone Company, furnishes the following: "This company has recently installed a new common battery board of the latest type, using the Dean four-party selective system. Our board is the first built by the Kellogg Company using 45 volts. During the past year we have added about 20,000 feet of cable and largely rebuilt the plant. The prospect seems good to add to our subscription list. We are hampered quite a bit by not having some good copper long distance lines. The toll lines we have cover the surrounding country for about 50 miles very well, but further than that we cannot get good service." The Kellogg switchboard installed here has a capacity of 3600; there are 950 subscribers at present.

SAN JUAN BAUTISTA, MEX.—Many new telephone exchanges have been established in towns in this state. There are at present 428 miles of telephone lines in the state of Tabasco of which this city is the capital.

MERIDA, MEX.—A submarine telephone cable is being laid across the arm of the Gulf between Progreso and near-by towns on the coast. An underground cable is also being laid between Merida and Progreso.

ELECTRIC LIGHT AND POWER.

BIRMINGHAM, ALA.—Bids will be received Nov. 24 by the Executive Committee Alabama Girls' Industrial School, Morris Hotel, for construction work and wiring for an electric light plant. Address Francis M. Peterson, president.

DOUGLAS, ARIZ.—The Douglas Improvement Company will increase the capacity of its electric light and power plant here. Additional machinery will be purchased.

CLIFTON, ARIZ.—George Pence, of El Paso, who is promoting the electric power project for this city and the town of Morenci, announces that he has interested New York capital in the enterprise and that the work of construction will commence as soon as the necessary surveys are completed. The power will be obtained from the San Francisco and Gila rivers and 4000-hp is promised.

BERKELEY, CAL.—A heating and lighting plant, to cost $50,000, is to be installed at the University of California. Plans for the new system have been prepared by John Galen Howard and Prof. C. L. Cory.

SAN FRANCISCO, CAL.—A. G. Wishon, manager of the San Joaquin Power Company, in which H. E. Huntington is interested, has received advices from Washington saying that his application for a power site on Government land on the Tule River in Fresno County, Cal., had been approved. The construction of an electric power house will be commenced in the near future, the location being 20 miles east of Porterville. About 600-hp can be developed.

SULPHUR SPRINGS, COLO.—The Hot Sulphur Springs Light, Power & Water Company has been organized with Frank N. Briggs, president, and D. P. Howard, secretary. This company proposes to construct water works and an electric light plant. Work will soon be commenced on a dam across Grand River in Byers' cañon, which will furnish water power for the enterprise.

WINDER, GA.—The city has purchased a site for an electric light plant, which will cost $15,000. It will have a capacity of 30 arc and 500 incandescent lamps.

EATONTON, GA.—The Eatonton Electric Cotton Mills and electric plant, together with two valuable water powers on Little River have been purchased by J. B. and Burke Floyd, of Savannah, Ga., for $42,000.

FAIRMOUNT, IND.—The town board is making arrangements to install an electric lighting plant, to cost $15,000. The citizens have agreed to pay five years' lighting bills in advance in order to ensure the installation of the plant.

SHOALS, IND.—The Martin County Hydraulic Company has been incorporated to construct a dam in east fork of White River, and build and operate a water plant to generate electric power. W. L. Stoy and D. A. Yoder are chief promoters.

RUSHVILLE, IND.—Bids will be received by Harry Lakin, City Clerk, on Nov. 19 for 100-kw and one 250-kw generators direct connected to engines; switchboard, piping, transformers, lights, etc.; also one for a 250-kw belted type single-phase generator, one engine arranged for belt, belting, switchboard, piping, lights etc.

SOUTH BEND, IND.—The South Bend Electric Company has been awarded the contract for lighting streets for a term of 10 years on a basis of 450 lamps, at 4,000 hours, as follows: For 7.5 ampere, series enclosed, alternating current, arc lamps, $78.75 with wood pole lines; $83 with iron poles and $95 with underground system; for 50-cp incandescent lamps, $30.60.

DELPHI, IND.—A great deal of interest is being taken here in the proposed improvement of the Wabash and Tippecanoe rivers. It is suggested to drain the Kankakee into the Tippecanoe which empties into the Wabash. The proposed scheme will solve the water power problem at Horse Shoe Bend where it is proposed to build a dam for power to generate electricity.

VINCENNES, IND.—The National Rolling Mill Company, anxious to complete its plant, asked the local electric light company to place arc lights in the street, so that work could be done night and day. The Rolling Mill Company

employs non-union labor and the union men employed by the electric light company refused to place the lamps in the street and in the company's offices. At a regular meeting of the council on Oct. 27 the electric light company was ordered to do the work or forfeit its franchise. The council held that the company must give the service and the refusal of one set of men to do the work was not sufficient excuse.

ESSEX, IA.—Farris & Eastman, of Clarinda, Ia., are reported interested in the construction of an electric light plant for Essex.

OTTAWA, KAN.—The city is discussing the question of municipal ownership of water and light, as a result of a request from the company which now has the contract for a renewal of the franchise.

DANSVILLE, KY.—It is proposed to construct an electric light plant, to cost about $30,000. Prof. Gordon is engineer.

NEW ORLEANS, LA.—The Special Lighting Commission of Council rejected the bid of the Colonial Electric Company of New York for the construction of a municipal electric light plant, and adopted a resolution authorizing the Comptroller to secure bids for lighting the city for 10 years as per specifications drawn by the City Electrician and City Attorney.

SARANAC, MICH.—The Village Board has granted D. G. Huhn a 30-year franchise for an electric light plant, and made a 10-year contract for lighting.

AITKIN, MINN.—It is stated that the Council will purchase additional machinery for the municipal lighting plant.

CHISHOLM, MINN.—P. E. Dowling and Jas. Falk, of Eveleth, Minn., have submitted a proposition to install an electric light plant.

SAG HARBOR, L. I., N. Y.—The citizens have voted to issue $24,000 bonds for an electric light plant.

FILLMORE, N. Y.—W. L. Youngs, of Fillmore, is interested in the Fillmore Electric Light & Power Company. Water power is to be used to generate electricity.

OTEGO, N. Y.—The Otego Lighting Company, of Otego, has been incorporated, to manufacture and sell electricity for light, heat and power purposes. Directors: B. Cook Broodfoot and Vincent S. Fuller, of Otego.

EDENTON, N. C.—The First National Bank of Elizabeth City has purchased the $30,000 issue of 5 per cent. 30-year water and electric light bonds issued by the town of Edenton, N. C.

CHARLOTTE, N. C.—An electric lighting plant consisting of a triple expansion engine with direct coupled dynamo and 110 arc lights has been ordered from the General Electric Company for the new Hoskins Cotton Mill at Charlotte.

SALISBURY, N. C.—The Yadkin River Electric Power Company, of Salisbury, has been incorporated, with a capital of $5,000,000, by the Whitney Company, of Salisbury; Geo. I. Whitney and H. L. W. Hyde, of Pittsburg, Pa., and Egbert R. C. Hambley, of Salisbury.

CHARLOTTE, N. C.—The Westinghouse Electric & Manufacturing Company is preparing plans on a contract for electrical equipment and machinery for a big water power plant on Catawba river at Mt. Island, N. C. E. D. Latta, of Charlotte, N. C., is interested. The new plant, it is said, will supply power for manufacturing and municipal use.

NEWTON FALLS, OHIO.—Wade Gardner, City Clerk, writes that the city is investigating the cost of water works, a sewerage system and electric light plant.

SHAWNEE, OKLA.—The Shawnee Light & Power Company has been organized with a capital stock of $200,000 for the purpose of establishing and operating an electric light and power plant here. C. N. Jackson, of Shawnee, is one of the incorporators.

HOUSTON, TEX.—The Water Works Company here is preparing to install an electric filter for the purpose of purifying all the water furnished the city for domestic purposes.

SAN SABA, TEX.—The San Saba Light & Ice Company has been organized here with a capital stock of $15,000. The company will install an electric light plant. The incorporators are T. C. Henry, J. W. Longley, John H. Martin, T. A. Murray, W. S. Sanderson and U. M. Sanderson, all of San Saba.

OLYMPIA, WASH.—The Kilbourne Clark Company, of Seattle, has secured the contract for the electric lighting plant for the capitol at $10,500.

WALLA WALLA, WASH.—It is stated that bids will probably be received Feb. 15 for the proposed $250,000 hydro-electric station on Walla Walla River for the North-Western Gas & Electric Company. Samuel Storrow, Los Angeles, Cal., is engineer.

NEW LONDON, WIS.—The citizens have voted to issue bonds for an electric light plant.

BELOIT, WIS.—According to press reports, Beloit College will build a central plant to supply steam heat and possibly electric light for the several buildings on the campus. The plant will be erected this fall and enlargements made next year; it will cost from $25,000 to $30,000.

HAMILTON, ONT.—Owing to the immense increase of business, the Cataract Power, Traction & Light Company has been obliged to secure more power, and has let a contract to F. H. Dickenson, of Hamilton, for a series of extensions, the first of which will be the enlarging of the power house at DeCew Falls.

OTTAWA, ONT.—A company, composed of residents of the city of Kingston, Ont., has secured the control of the Mississippi Falls, about 55 miles from Kingston with the intention of developing power there. It is stated that upwards of 10,000-hp can be easily obtained at these falls, and could be profitably marketed at from $15 per horse power per annum. There is a fall of 85 feet at this point. Drawings, etc., have been secured and submitted to an expert for his report.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—H. M. Russell, of the Ventura & Bakersfield Electric Railway Company, has just returned from the East, where, it is stated, he has floated $3,500,000 of bonds. Construction work has actually begun, and a graders' camp is established at Oxnard. Considerable difficulty was experienced in getting water-front privileges at Hueneme.

LOS ANGELES, CAL.—It is stated that H. E. Huntington is to be associated with President Harriman, of the Southern Pacific, in the work of building electric railways throughout southern California. It is announced that Harriman has purchased at least one-third of the stock of the Pacific Electric Railway Company and other corporations of which Huntington is the head. This move is made by Harriman to share in the profits of the electric lines that parallel the Southern Pacific.

MACON, GA.—The Macon Railway & Light Company has installed in its plant here a steam turbine of 1000 horse-power.

CANTON, ILL.—The Illinois General Electric Railway Company, recently incorporated to build an electric railway at Canton, has organized as follows: U. G. Orendorff, president; W. O. Dean, first vice-president; R. F. Henkle, second vice-president; James A. Lawrence, third vice-president; W. D. Plattenberg, secretary; E. A. Heald, treasurer.

COLUMBUS, IND.—The City Council has granted a thirty-five year franchise to the Columbus, Greensburg & Richmond Traction Company.

LAPORTE, IND.—The City Council has granted a fifty-year franchise to the Northern Traction Company of Indiana, which is projecting an interurban line from South Bend to Chicago, via this city, Valparaiso and Hammond.

SOUTH BEND, IND.—George F. McCulloch, president of the Union Traction Company, is fostering a scheme of centralization for the lines entering this city. It includes the merger of the Indiana Railway Company, the South Bend & Southern Michigan Railway Company, the Indiana Western Railway Company and probably the Chicago & Indiana Air-Line Railway Company, with a line which Mr. McCulloch is now building from Peru to South Bend. When these lines are completed there will be a chain of lines reaching from Indianapolis to St. Joseph, Mich., with a network of feeders crossing Northern Indiana from east to west.

COUNCIL BLUFFS, IA.—The promoters of the Council Bluffs, Tabor & Southern Electric Railway company are now in the East negotiating the sale of bonds for the new line from Council Bluffs to Rockport, Mo.

TABOR, IA.—The promoters of the electric railway from Council Bluffs, via Tabor to Rockport, Mo., known as the Council Bluffs, Tabor & Southern Electric Railway Company, are now in the East negotiating the sale of bonds.

WASHINGTON, IA.—The organization of the Iowa City, Kalona & Washington Railway Company has been completed by filing articles of incorporation with the Secretary of State. The main line of the company will extend from Iowa City, via Kalona to Washington, a distance of about 35 miles. The capital is $50,000. The officers are G. G. Rodman, president; W. P. Coast, vice-president; W. J. Welch, secretary; C. M. Keck, treasurer. These named parties, with G. S. Carson, G. W. Wagner, W. G. Smith, A. N. Alberson and S. W. Brookhart, constitute the board of directors.

LAKE CHARLES, LA.—C. L. Bland, representing the company which owns the Shreveport Electric Railways, is in the city negotiating with the local street car company to purchase its track and franchise. If the deal is closed the new owners will put in an electric line, it is said.

BALTIMORE, MD.—The United Railways & Electric Company is considering a plan to extend its Charles Street line to Roland Park.

MAYNARD, MASS.—The Lowell, Acton & Maynard Street Railway Company has completed its electric railway between Maynard and South Acton, Mass.

WORCESTER, MASS.—At the annual meeting of the Worcester & Blackstone Valley Street Railway Company M. J. Whittall, of Worcester, was re-elected president; Alfred Thomas, vice-president and treasurer, and Willard Ballon, clerk.

BROCKTON, MASS.—Local reports are to the effect that Stone & Webster, of Boston, are considering the question of building an electric railway between Brockton and Stoughton. A line over this route was originally projected by the Brockton, Canton & Dedham Company.

BOSTON, MASS.—The Blue Hills Street Railway Company has petitioned the Railroad Commissioners for authority to issue first mortgage bonds, not to exceed $250,000, for building branches and extensions, power houses and car houses, acquiring and equipping additional rolling stock, abolishing grade crossings and paying betterment assessments for widening streets.

BOSTON, MASS.—The Railroad Commissioners have approved the petition of the Marlborough & Framingham Street Railway Company for authority to issue capital stock to the amount of $105,000 for the purpose of purchasing, at the receiver's sale, the street railway property formerly belonging to the Marlborough Street Railway Company and to make permanent improvements thereon.

LANSING, MICH.—The St. Louis Electric Railway Construction Company will be incorporated under the laws of the State of Michigan for the purpose of building an electric railway line from Grand Rapids to Saginaw via Ionia, Hubbardston, Carson City, Summer, Crystal Lake, Ithaca, Alma and St. Louis, a distance of about 110 miles. Marcus Pollasky, of Detroit, is the principal promoter.

LANSING, MICH.—The Michigan & Indiana Traction Company has been incorporated under the laws of Michigan to succeed the Michigan Central Traction Company and build an electric railway from Battle Creek to Lansing

via Grand Ledge. The capital stock of the company is $200,000, and the organizers are E. F. Pangborn, C. J. Austin and W. N. Dibble, all of Battle Creek.

ST. PAUL, MINN.—President Thomas Lowry, of the Twin City Rapid Transit Company, says that the directors will take up the proposed new interurban line this winter, and it is not at all unlikely that construction work may be taken up in the early spring. Mr. Lowry says it also possible that the company may build to White Bear Village next spring.

GREENWOOD, MISS.—The City Council of Greenwood has granted a fifty-year franchise to the Greenwood Electric Company, which contemplates building an electric railway to be eventually extended to a number of nearby towns.

ST. LOUIS, MO.—Bids were opened Oct. 23 by the Board of Public Improvements for the extension of the municipal railway from Baden to Bissell's Point. The lowest bidders were Fruin & Colnon, at $45,404.75. The Board will doubtless award them the contract.

JERSEY CITY, N. J.—The Hoboken & Manhattan Railroad Company, of Jersey City, has been incorporated to construct the New Jersey end of the trolley tunnel entrance to New York; capital, $500,000. Incorporators: William G. McAdoo, Frederick B. Jennings, Edward F. C. Young, Charles L. Corbin, H. P. McCullough, Edward R. Green, Charles W. King.

BALLSTON SPA., N. Y.—It has been decided to extend the Ballston Terminal Railroad straight through Saratoga County to Hagaman's, where it will meet the Amsterdam trolley extension, making a through line from Amsterdam to Albany.

SYRACUSE, N. Y.—At the annual meeting of the stockholders of the Syracuse, Lakeside & Baldwinsville Railway the following officers were elected: W. Judson Smith, president; Franklin J. Kaufman, vice-president; A. R. Peck, treasurer, and E. J. Chapman, secretary.

PORT WASHINGTON, N. Y.—At the election on Nov. 3 a resolution was voted upon to grant a franchise for the construction of an electric railway along the North Hempstead Turnpike from the dividing line between the townships of Oyster Bay and North Hempstead to the Greater New York line at Little Neck.

TOLEDO, OHIO.—The Toledo, Bay Shore & Michigan Railway Company has been incorporated by Frank D. Cope and Frank B. Gunning, of Pittsburg; Frank M. Ohl, Willis F. Brown and J. R. W. Cooper, of Toledo.

ZANESVILLE, OHIO.—Fred S. Colby, of Newark, is surveying a line from Zanesville to Cambridge. This will connect with the Columbus, Newark & Zanesville Traction Company's line now being completed into Zanesville. The line will be eventually extended to Wheeling.

LAWTON, OKLA.—The Lawton, Wichita Mountain & Western Electric Railway Company has been incorporated with $220,000 capital. The incorporators are C. W. Johnson, of Montgomery, Ala.; S. P. Brunbage, of St. Louis; J. R. Bratton, of Carthage, Mo.; Edward F. Mitchell, of El Reno; D. R. Rankin, R. A. Hubard, Charles Mitscherick and J. H. Russell.

SUMPTER, ORE.—A project is being pushed here for the construction of an electric railway between this city and Bourne. Three-fourths of the capital required, estimated at $100,000, will be put up by Henry Hewett, of Tacoma, and the balance of the total cost will be raised among the mining men operating in the vicinity of the two cities.

HARRISBURG, PA.—It is reported that J. M. Stockbridge, J. H. Alexander and other Detroit capitalists are forming a company to construct an electric railway between this city and Lebanon.

CHAMBERSBURG, PA.—Officials of the Chambersburg & Gettysburg and Chambersburg, Greencastle & Waynesboro Electric Railway Companies were in conference here recently on the proposition to build an electric railway from Fort London to Blair's Mills. The power house and car house will probably be located at Dry Run.

HARRISBURG, PA.—Charters have been issued by the State Department as follows: Irwin & McKeesport Railway Company, capital stock, $45,000; president, John George, Irwin; directors: Charles Fritchman, Frank M. Fritchman, William W. George, John George, Irwin; Joseph C. Boyd, Pittsburg; The Lancaster & Southern Street Railway Company, capital stock, $84,000; president, James G. McSparran, Furniss; directors: C. A. Fondersmith, William Wohlsen, Thomas K. Worthington, Frederick Shoff, Lancaster; James G. McSparran, Furniss. California & Allen Port Street Railway Company, capital stock, $50,000; president, R. B, Drum, California; directors: W. C. Smith, E. C. Drum, C. H. Drum, A. T. Morgan, California. Bank & Broad Street Railway Company, capital stock, $5000; president, J. C. Boyce, Pittsburg; directors: Hugh M. Stilley, Scott Township; George Hughey, West Liberty; George A. Krupp, Paul S. Ache, J. C. Boyer, Pittsburg. The Farmersville & Terre Hill Street Railway Company, capital stock, $48,000; president, S. M. Seldomridge, Farmersville; directors, E. H. Burkholder, A. E. Burkholder, S. M. Seldomridge, Farmersville; Dr. B. J. Reemsnyder, Hinkletown; John H. Fry, Lancaster.

PROVIDENCE, R. I.—The Providence & Burrillville Street Railway Company has been granted a franchise in Lonsdale to build an electric railway through the town from the Woonsocket boundary to the North Providence boundary line of the town.

RICHMOND, VA.—The Virginia Passenger & Power Company is reported to have engineers in the field surveying for a line from Richmond to Ashland, about 16 miles.

SALEM, W. VA.—Homer B. McKinley, of Salem, is reported to have secured a street railway franchise in Clarksburg for the Salem Terminal Traction Company, which will begin constructing next spring.

HAMPTON ROADS, VA.—The Vandergrift Construction Company, of Philadelphia, has filed a lien for $112,944 against the Hampton Roads Railway & Electric Company, which is claimed to be the balance due for construction work for the company which recently went into the hands of a receiver.

CHARLOTTESVILLE, VA.—The property of the Charlottesville City & Suburban Railway Company is advertised to be sold at Charlottesville on Nov. 10, under foreclosure of mortgage. The property includes a street railway (3½ miles), ice plant, electric plant, 110 acres of land, with mineral springs, hotel, etc. The sale will be made subject to a mortgage of the Piedmont Construction & Improvement Company, dated Feb. 1, 1895, to secure $25,000 first mortgage bonds, and also subject to a lien to secure the payment for new rails recently bought by the company. The mortgage trustees are Micajah Woods, R. T. W. Duke, Jr., and C. Guy Robinson.

WHEELING, W. VA.—It is said that the Wheeling & Western Traction Company, which is controlled by interests identified with the Wheeling Traction Company, is completing the preliminaries looking to the early construction of its proposed line between St. Clairsville and Barton.

VENADO, MEXICO.—A project is on foot to build an interurban electric railway between this place and towns and this section, with a connection to be made with the Mexican National Railroad.

NEW INDUSTRIAL COMPANIES.

THE INTERNATIONAL ELECTRIC METER CO, Chicago, has been incorporated to manufacture electric specialties; capital, $10,000. Incorporators: W. W. Cheney, Jr., Samuel Solomon, O. C. Peterson.

THE WESTERN AUTOMOBILE COMPANY has been incorporated at St. Louis, Mo., with a capital stock of $10,000, all paid. The incorporators are Marion L. J. Lambert, Samuel Breadon and Samuel B. McPheeters.

THE NICHOLAS LIGHTNING ARRESTER COMPANY has been incorporated at Columbus, Ohio, with a capital stock of $15,000 by C. E. Nicholas, Savannal Nicholas, Wm. A. Hopkins, Jr., T. R. Prall and Edward B. Thomas.

LEGAL.

SUBWAY FRANCHISE IN NEW YORK.—Mr. George Hill, counsel for the Independent Telephone Company, has applied to Justice Clarke, in the New York Supreme Court, for a peremptory mandamus to compel Commissioner Robert G. Monroe, of the Department of Water Supply, Gas, and Electricity, to permit the company to construct and maintain its lines of electrical conductors in the present subways of the Underground Rapid Transit Railroad Company, and to construct whenever necessary such subways throughout the city to carry its lines. The city was represented by Assistant Corporation Counsel Edward J. McGuire, who presented an affidavit of Alexander E. Orr, president of the Rapid Transit Commission, to the effect that this company had not received permission from the commission to occupy any portion of the conduits of the underground railway or to place its lines in the streets. The moving company, Mr. McGuire said, had absolutely no rights in the streets of the city, and the acts of the commission could not be controlled by the court. He said that if the application were granted the company would make an effort to place its wires in any and every street in the city. Justice Clarke reserved decision.

OBITUARY.

MR. W. L. ELKINS.—We regret to note that Mr. William L. Elkins, the street railway magnate, died on November 7 at his residence, Ashbourne, near Elkins Park, Pa., after an illness of more than a month. Death was directly due to heart failure caused by hardening of the arteries. He is survived by three children—George W. Elkins, Mrs. George D. Widener and Mrs. Sidney Tyler. Mr. Elkins was born on May 2, 1832, in western Virginia, of Quaker parentage. He was educated in the Philadelphia public schools, and at the age of 16 he engaged in the lumber business. In 1852 he entered the produce and shipping business, dealing extensively in agricultural products. Later he sold out his business and going to western Pennsylvania became interested in the production of oil. Returning to Philadelphia he engaged in the business of refining crude oil and in this way laid the foundation of his immense fortune. He was identified with the oil interests until 1880 when he sold out his interests to the Standard Oil Company. In association with P. A. B. Widener and W. H. Kemble he then became interested in street railways all over the country and with them organized the Philadelphia Traction Company, which recently became the Philadelphia Rapid Transit Company. Mr. Elkins was one of the re-organizers of the United Gas Improvement Company and was president and director of many other enterprises, including the Electric Storage Battery Company, the Philadelphia Electric Company, Electric Company of America, Consolidated Traction Company of New Jersey, etc.

EDUCATIONAL.

WORCESTER POLYTECHNIC INSTITUTE.—During the last few months two exceedingly interesting machines have been built at the Washburn shops of the Worcester Polytechnic Institute, under the direction of the U. S. Bureau of Forestry. These machines were designed for the driving of screw spikes into railroad ties at the Worcester Polytechnic Institute by Alton L. Smith, professor of machine design. These screw spikes are designed to replace the spike ordinarily used by railroad companies, and an effort will be made by the Bureau of Forestry to introduce their use into this country. They are already extensively used in France, Belgium, Germany and other Euro-

pean countries. The advantage of the screw spike lies in the fact that it will allow the use of softer wood for railroad ties than is possible where the ordinary form of spike is employed. If the machines which have just been built are successful, it is expected that many of the softer kinds of wood, such as spruce and poplar, can be employed for railroad ties. With the old form of spike, experiment has shown that the life of one of these ties did not exceed six or eight months, but with the screw spike it is expected that they will last for some years. One of the machines in question was built for the New York Central and the other for the Pennsylvania Railroad Company.

PERSONAL.

DR. J. W. RICHARDS, of Lehigh University, is to lecture on November 12 before the Franklin Institute on "The Electrolysis of Water."

MR. W. McL. WALBANK, formerly general manager of the Lachine Hydraulic & Land Company, of Montreal, has been appointed to be first vice-president and chief engineer of the Montreal Light, Heat & Power Company.

MR. F. W. LE TALL, who is a patent agent connected with the Westinghouse patent bureau in London, is now on a visit to the United States, and is taking the opportunity to study American electrical and engineering practice.

MR. THOMAS M. JENKINS has resigned as general manager of the St. Louis & Suburban Railway Company, St. Louis, Mo. Mr. Jenkins has not outlined his plans for the future, but it is understood that he will remain in St. Louis.

MR. B. B. THWAITE, of England, is now visiting this country in connection with his blast furnace power system, of whose efficiency favorable reports have been received here. He is also known in connection with the development of plans for the application of electricity on canals.

MR. IRVING H. REYNOLDS will shortly retire from the Allis-Chalmers Company and the duties of chief engineer will be assumed by the engineers in charge of the various departments; these engineers availing themselves of the advice of Mr. Edwin Reynolds, the consulting engineer of the company.

MR. D. W. COONS has severed his connection with the Hydra Battery Company as a director and treasurer. He has been in poor health for some months and has left New York for the Magno mud baths at Attica, Ind., going thence to Los Angeles, Cal., for a complete rest before resuming business.

MR. J. J. BELLMAN has recently been elected vice-president of the Indestructible Road Bed Company, which controls the franchises and charter of the Sandusky, Monroeville, Belleville and Norwalk Traction Company. It is expected that active construction on this road will commence in the Spring, with Bellman & Sanford as electrical engineers.

SIR CHARLES METCALFE, who has been in this country for a few weeks, accompanied by his partner, Mr. G. A. Hobson, has sailed for England, after visiting some of the power transmissions and electrical factories. As already noted, he is deeply interested in the plan for utilizing some of the vast power of the Victoria Falls on the Zambesi River.

COL. ISAAC M. HUTCHISON, of Mexico City, who represents the interests of several prominent American manufacturing concerns in the southern republic, has left for Mexico after several weeks' visit to the States. He is president of the Mexican Car & Foundry Company, which is to build a plant in Mexico City. Contracts for equipment comprising electric plant machine tools, etc., will be awarded immediately.

MR. JOHN MAHONEY has been appointed general superintendent of the St. Louis & Suburban Railway Company, St. Louis, Mo. Mr. Mahoney is a practical street railway man of nearly thirty years' experience. In his new duties, Mr. Mahoney will have complete charge of the operation of the lines while most of the duties of former general manager Jenkins will devolve upon Julius S. Walsh, Jr., son of President Walsh, who has been vice-president of the road since last January.

MR. ALEX. HENDERSON, of the conduit department of the Sprague Electric Company was the recipient last week of a very flattering testimonial from the electrical contractors of the country. The members of the Electrical Contractors Association of New York City had a beefsteak banquet at the famous "Morgue" on November 5, when 75 persons were present, including several leading architects and electrical engineers. During the course of the evening Mr. Charles L. Eidlitz presented Mr. Henderson with a handsome silver loving cup with this inscription: "Presented to Alexander Henderson, M. T., by his friends in the National Electrical Contractors' Association, 1903." The "M. T." had reference to Mr. Henderson's valued services as master of transportation, but the qualities of the recipient were also a strongly prompting motive. The "M. T." might also be said to have reference to the cup itself. If Sir Thomas Lipton wants lessons in cup lifting he should have been on hand that night.

Trade Notes.

OIL FILTER.—The Cleveland & Electric Illuminating Co., Cleveland, Ohio, has just sent a duplicate order for a 200-gallon oil filter with automatic water separating device, to the Burt Mfg. Co., Akron, Ohio.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out samples of its O. K. duplex telephone wire. It is made in three colors: brown, maroon and black. Sample and prices will be gladly furnished upon application.

THE STATION EQUIPMENT COMPANY, 204 Dearborn St., Chicago, has brought out in an attractive booklet a list of machinery which it has on hand ready for immediate delivery. The book contains 28 pages, devoted to direct and alternating current generators, motors, engines of various types, boilers, motor-generators, transformers, etc.

THE CUTLER-HAMMER MFG. COMPANY, of Milwaukee, Wis., states that its catalogue presents the most complete line of electric controlling devices ever listed. Every consulting electrical engineer is advised to secure a copy to put on file for reference. It will be gladly furnished on request, and the applicant's name added to the mailing list to insure receipt of further bulletins as issued.

EDISON STORAGE BATTERY COMPANY, Edison Laboratory, Orange, N. J., has just issued its first catalogue, and a very handsome one it is. We recommend every one of our readers to send and get a copy, for it not only shows the battery in its complete present form, but illustrates the parts and gives a large amount of descriptive and technical text. It is understood that in addition to the type of battery here shown, the company is now developing three or four more for special lines of work, to be put on the market next Spring. Some details about these cells are also given.

SPECIAL TRAIN DE LUXE.—Mr. Milton C. Roach, the General Eastern Passenger Agent of the New York Central Railroad, who is well known in electrical circles, has just returned from a most successful personally conducted trip with the New York City Group No. 8 of bankers attending the recent bankers' convention in San Francisco. The special train, which was luxuriously equipped, had aboard no fewer than 125 ladies and gentlemen, and the run out and home over eight railroad systems covered more than 7500 miles. Mr. Roach has received many congratulations upon the success attending this run, and a great many people in the electrical field have expressed the wish and hope that some day either the National Electric Light Association or the American Street Railway Association, or both, will be tempted to make a similar run out to the Coast. Neither national body in some 20 years of existence has ever got even so far as Denver, and in view of the remarkable electrical developments all over the Pacific Slope, it is thought high time that Mr. Roach were given an opportunity to show that he can take as good care of electrical magnates as he can of bankers.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 3, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

742,830. METALLURGICAL PROCESS; Oliver W. Brown, Bloomington, and William F. Oesterle, Marion, Ind. App. filed May 14, 1903. (See page 806.)

742,852. ELECTRIC FURNACE; William S. Franklin, South Bethlehem, Pa. App. filed Dec. 3, 1900. (See page 805.)

742,856. BATTERY; James W. Gladstone, West Orange, N. J. App. filed Sept. 17, 1903. (See page 806.)

742,857. BATTERY; James W. Gladstone, West Orange, N. J. App. filed Sept. 17, 1903. (See page 806.)

742,861. SYSTEM OF ELECTRICAL DISTRIBUTION; Josef H. Hallberg, New York, N. Y. App. filed Feb. 20, 1903. A motor having its field magnets connected across the distributing circuit and its armature supplied by a constant potential, operates certain devices for varying the excitation of the field magnet of the main generator to maintain the potential of the current in the distributing circuit, constant.

742,863. ELECTROLYTIC APPARATUS; Edouard Hannon, Brussels, Belgium. App. filed Oct. 4, 1898. (See page 806.)

742,864. ELECTROLYTIC PROCESS; Edouard Hannon, Brussels, Belgium. App. filed Oct. 4, 1898. (See page 806.)

742,865. ELECTROLYTIC PROCESS; Edouard Hannon, Brussels, Belgium. App. filed Oct. 4, 1898. (See page 806.)

742,886. CHARGING SYSTEM FOR SECONDARY BATTERIES; Hiram Percy Maxim, Pittsburg, Pa. App. filed March 12, 1903. (See page 806.)

742,890. TELEPHONE TIE-WIRE; George F. Moore, Jr., Mobile, Ala. App. filed July 29, 1902. (See page 806.)

742,895. CUT-OUT FOR ELECTRIC CIRCUITS; Edgar Mosher North, Brooklyn, N. Y. App. filed Jan. 21, 1903. (See page 807.)

742,906. ELECTRIC SWITCH; James T. Robb, New York, N. Y. App. filed April 15, 1903. A switch adapted for chandeliers and having a frame within which the operative parts are mounted and which is carried within a yoke secured to the fixture, whereby the yoke can be adjusted and the switch afterwards introduced in place.

742,926. POTENTIAL REGULATOR FOR ALTERNATING CURRENT CIRCUITS; Harve R. Stuart, Wilkinsburg, Pa. App. filed March 12, 1903. A transformer having a plurality of windings each of which comprises electrically connected, but physically separated coils, the electrical connections being such that the outer coils constitute the inner portions of the circuit.

742,933. ELECTRIC MOTOR CONTROLLER; Walter N. Vance, Chicago, Ill. App. filed July 2, 1902. A railway controller, the object of the invention being especially to insure safety in operation, the various parts being interconnected and interlocked to prevent a change of circuit unless the conditions for the change are first made right.

742,963. ELECTRIC HEATER FOR LIQUIDS; Frank Briggs, Torquay, England. App. filed Aug. 23, 1902. Two elongated electrodes are located in a tank for liquid, the liquid being heated by the passage of current through it between the electrodes.

742,976. ALTERNATING CURRENT CIRCUIT CONTROLLER; Cornelius D. Ehret, Philadelphia, Pa. App. filed April 5, 1902. Control circuits and apparatus controlled thereby, such circuits being so adjusted as to their electrical constants that a change in frequency of the energy flowing in them will cause either a rise or fall of potential in the control circuit, such variation being utilized to control the main circuit.

742,997. MANUFACTURE OF ELECTRICAL INSULATING MATERIAL; Carl Jung and Adolf Kittel, Vienna, Austria-Hungary. App. filed April 21, 1900. An insulating material containing a mixture of casein, oil and sulphur vulcanized.

743,011. TELEGRAPHIC TRANSMITTING ATTACHMENT FOR TYPE-WRITERS; Albert E. Morelock, Topeka, Kan. App. filed Jan. 27, 1903. An attachment for typewriters wherein the stroke of a key suffices to put in operation mechanism which automatically transmits the dots and dashes which denote the letter represented by the key.

743,012. TELEGRAPHIC TRANSMITTER; Albert E. Morelock, Topeka, Kan. App. filed May 11, 1903. A modification of the preceding invention.

743,024. ELECTRICAL DISPLAY SYSTEM; Francis L. O'Bryan, Winston-Salem, N. C. App. filed Dec. 20, 1902. An improved switching apparatus for electric signs.

743,028. STEADYING RESISTANCE FOR ELECTRIC LAMPS; Henry N. Potter, Gottingen, Germany. App. filed Aug. 9, 1899. The ballast conductor in series with the glower has a resistance which increases at an abnormally high rate when traversed by current that is greater than the normal maximum for the glower.

743,029. BALLAST DEVICE FOR ELECTRIC LAMP CIRCUITS; Henry N. Potter, Pittsburg, Pa. App. filed Dec. 29, 1899. The temperature of the ballast is raised during the period of heating the glower to conductive temperature, so that the ballast will be in condition to prevent the initial inrush of current through the glower.

743,030. TERMINAL FOR ELECTRIC LAMP GLOWERS; Henry N. Potter, New Rochelle, N. Y. App. filed May 1, 1903. An electric lamp glower having a distributed metal terminal, every portion of which is substantially equi-distant from a given point in the axis of the glower body.

743,306.—Therapeutic Appliance.

743,031. INSULATING MATERIAL; George T. Pratt, Westbrook, Maine. App. filed Jan. 24, 1902. The material is composed of leather pulp having a strengthening fibre mixed therewith and impregnated with mineral wax, rosin and alum.

743,044. DYNAMO; John D. Spence, Somerville, Mass. App. filed Sept. 28, 1901. The invention resides in having one of the windings of a compound wound armature used for the field excitation in connection with a secondary battery.

743,056. WIRELESS TELEGRAPHY; Ferdinand Braun, Strassburg, Germany. App. filed April 18, 1899. (See Current News and Notes.)

743,082. DYNAMO-MACHINE; Dugald C. Jackson, Madison, Wis. App. filed Aug. 11, 1902. (See Current News and Notes.)

743,101. RAILWAY BOND; Henry E. Procunier, Oakpark, Ill. App. filed Sept. 22, 1902. Relates to the formation of the terminal of the bond which is driven into a hole in the rail.

743,102. BATTERY-GRID; Gustav H. Rabenalt, Buffalo, N. Y. App. filed Nov. 5, 1902. (See page 806.)

743,122. PRINTING TELEGRAPH RECEIVER; James D. White, London, Eng. App. filed Jan. 3, 1903. Details of a page printer.

743,136. WIRE WINDING MACHINE; John G. Bauer, Ravenna, Ohio. App. filed April 24, 1903. A machine for winding wire around a flat carbon brush.

743,153. TROLLEY MECHANISM; Charles I. Earll, New York, N. Y. App. filed Sept. 20, 1901. The trolley cord passes over a sheave at the upper end of the pole and thence through the tubular pole to a spring drum at the base thereof.

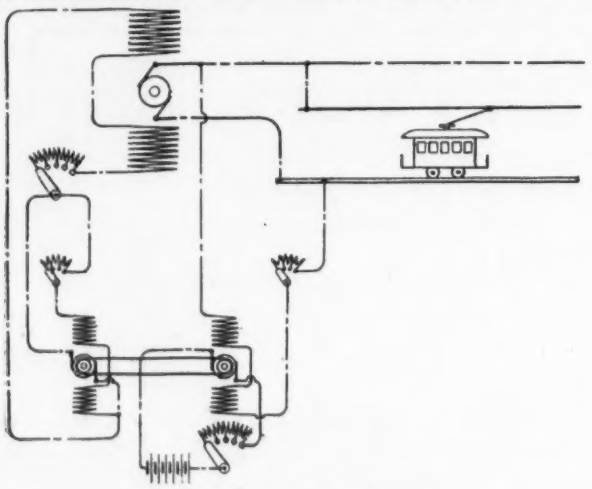
743,173. RATCHET OPERATED ELECTRIC SWITCH; William Kingsland, London, England. App. filed June 1, 1903. Details.

743,188. ACCUMULATOR PLATE OR GRID; Johannes von der Poppenburg, Charlottenburg, Germany. App. filed May 13, 1903. (See page 806.)

743,206. INCANDESCENT ELECTRIC LAMP SOCKET; August Weber, Sr., Schenectady, N. Y. App. filed Dec. 10, 1902. Improvements in the locking connection between the sleeve and cap of the socket.

743,207. INCANDESCENT ELECTRIC LAMP SOCKET; August Weber, Sr., August Weber, Jr., and John Weber, Schenectady, N. Y. App. filed Feb. 13, 1903. Details of the insulating base and the manner in which the switch mechanism is mounted thereupon.

743,236. ELECTRODE FOR ARC-LAMPS; Hugo Bremer, Neheim, Germany. App. filed Aug. 5, 1899. (See Current News and Notes.)



742,861.—System of Electrical Distribution.

743,237. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed March 7, 1900. (See Current News and Notes.)

743,238. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed May 2, 1901. (See Current News and Notes.)

743,239. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed Nov. 23, 1901. (See Current News and Notes.)

743,240. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed July 16, 1902. (See Current News and Notes.)

743,241. ELECTRIC-ARC LAMP; Hugo Bremer, Neheim, Germany. App. filed Aug. 2, 1902. (See Current News and Notes.)

743,245. RAILROAD SIGNAL AND ALARM; Albert E. Caughey, Omaha, Neb. App. filed May 2, 1901. A railway signal comprising a starting mechanism in circuit with track wires, a vibrating armature to strike a gong and a device for operating the starting mechanism to reset the same after the signal has been actuated for a suitable length of time.

743,246. COMBINED CUT-OUT AND CONTROLLING SWITCH; Lee S. Chadwick, Ridley Park, Pa. App. filed Feb. 11, 1903. A pin switch used to disable the primary circuit of a spark coil, the switch being attached to the steering wheel of an automobile.

743,272. SAFETY TROLLEY ALARM; William M. Gruner and William C. Fink, Springdale, Pa. App. filed Sept. 14, 1903. A second trolley wheel with a wide tread follows the main wheel to engage with the wire when the main wheel leaves it, and an alarm is sounded when the event occurs.

743,273. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed Jan. 10, 1903. (See page 806.)

743,274. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed June 23, 1903. (See page 806.)

743,275. ELECTRIC BATTERY; Henry Halsey, New York, N. Y. App. filed June 23, 1903. (See page 806.)

743,281. SWITCH; Martin E. Hepburn, Chicago, Ill. App. filed Feb. 12, 1903. Details.

743,306. THERAPEUTIC APPLIANCE; George M. D. Merwin, St. Louis, Mo. App. filed March 10, 1903. A translucent colored tube containing an electric lamp, an electric heater and medicinal salt, whereby actinic rays, warmth and medicated vapors can be conveyed directly to a diseased membrane.

743,315. DIRIGIBLE TORPEDO; David W. McCaughey, Chicago, Ill. App. filed Jan. 8, 1902. The various electro-magnetic devices for controlling the speed, rudder, etc., are operated by variations of intensity of current through a single conductor.

743,331. MEANS FOR REMOVING SLEET, ETC., FROM ELECTRICAL CONDUCTORS; Elias E. Ries, New York, N. Y. App. filed Sept. 4, 1903. The power rail or conductor is made a part of a second circuit carrying a current of large heating capacity.

743,337. BATTERY; Georges Schauli and Dolf Loewenstein, London, England. App. filed July 14, 1903. (See page 806.)

743,346. ELECTRICAL CONNECTOR; Joseph G. Swain, Youngstown, Ohio. App. filed Nov. 20, 1902. Details.

743,348. ELECTRIC SWITCH; George B. Thomas, Bridgeport, Conn. App. filed June 8, 1903. Details.

743,353. DEVICE FOR DISINFECTING TELEPHONES; Nelson J. Tubbs, Louisville, Ky. App. filed March 18, 1903. (See page 807.)

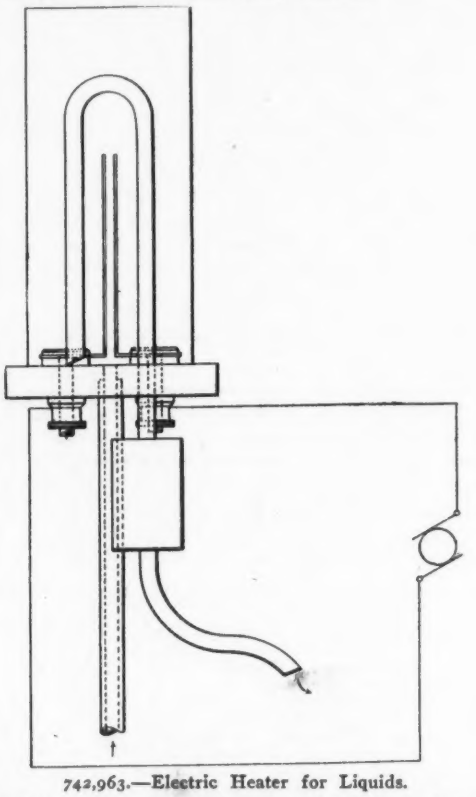
743,358. INCANDESCENT ELECTRIC LAMP SOCKET; August Weber, Jr., Schenectady, N. Y. App. filed June 25, 1903. Details.

743,364. ELECTRIC MOTOR; Edward B. Wilford and Adolph W. Schramm, Philadelphia, Pa. App. filed Aug. 10, 1903. By connecting the armature to the field winding in such a manner that a portion only of said winding is in series with the armature, the remaining portion gives rise to an action which maintains the armature and field current in phase with each other.

743,372. MAGNETIC MEDICAL APPARATUS; Emile Bachelet, Tacoma, Wash. App. filed Aug. 12, 1903. An apparatus by which the human body or a portion thereof can be placed in a magnetic field.

743,373. ELECTRO MAGNETIC THERAPEUTIC APPARATUS; Emile Bachelet, Tacoma, Wash. App. filed Oct. 2, 1903. A modification of the preceding patent.

743,378. AUTOMATIC SELF-DROPPING TROLLEY POLE; John Delane, Terre Haute, Ind. App. filed March 23, 1903. The rise of the trolley pole above the wire actuates a trip allowing it to fall to the roof of the car, the last part of the movement being retarded.



742,963.—Electric Heater for Liquids.

743,384. APPARATUS FOR BREAKING ELECTRIC ARCS; Harold Hastings, London, Eng. App. filed March 21, 1903. A series of blades placed above and below across the space occupied by a fuse; the blades are connected with the conductors through a resistance and are said to be effective in destroying an arc.

743,396. METHOD OF OPERATING ELECTRIC LAMPS; Henry N. Potter, Pittsburg, Pa. App. filed Feb. 14, 1901. Consists in raising the temperature of the ballast and inducing therein the condition under which it produces its maximum corrective effect, before the glower has been brought to a conductive state.

12,165. SAFETY SPEED LIMITING MEANS; Garrett W. Henricks, Indianapolis, Ind. App. filed May 28, 1901. The magnetic generator used to supply the spark in gas engines is mounted in an adjustable manner so that the pressure of its pulley against the fly-wheel of the engine can be varied.